

Northwest Research Obsidian Studies Laboratory Report 2003-53

Obsidian Hydration Analysis. The [redacted] from [redacted] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) that were characterized by X-ray fluorescence trace element analysis were also prepared for obsidian hydration analysis but yielded only 29 measurable rims. Although we were able to successfully measure only 10 hydration rims on the [redacted] from [redacted] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) that were correlated with the [redacted] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) source, this was not unexpected. The success rate with [redacted] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) from this source has always been rather poor in the past projects. The [redacted] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) is generally opaque and somewhat crystalline and visible hydration rims are often not present or are unreadable.

The specimen slides are curated at the Northwest Research Obsidian Studies Laboratory under accession numbers 2003-06 and 2003-53. The results are reported in Table B-1 in the Appendix and are summarized in Table 3. Available hydration rate information is presented in Table 4.

Table 3. Summary of results of obsidian hydration analysis of [redacted] from sites [redacted]
Hydration rim widths are reported in microns.

	Archaeological Sites	
Geologic Source	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	Total
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)		
Total	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	

Table 4. Hydration rate information reported in the literature for obsidian sources identified in the current investigation. Table is continued on following page.

Geologic Source	Rate	Comments	References
	—	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	^A Skinner 1995b
	$2.9 \mu\text{m}^2 / 1000 \text{ yrs}^{\text{B}}$ $3.0 \mu\text{m}^2 / 1000 \text{ yrs}^{\text{C}}$ $2.2 \mu\text{m}^2 / 1000 \text{ yrs}^{\text{D}}$ $1.5 \mu\text{m}^2 / 1000 \text{ yrs}^{\text{D}}$		^B Friedman 1977 ^C Friedman and Obradovich 1981 ^D Connolly and Byrsm 1999 ^E Skinner 1995b

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Table 4 (continued). Hydration rate information reported in the literature for obsidian sources identified in the current investigation.

Geologic Source	Rate	Comments	References
	—	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	^F Skinner 1995b
	1.56 $\mu\text{m}^2/1000 + 42 \text{ yrs}^G$ 4.0 $\mu\text{m}^2/1000 \text{ yrs}^I$		^G Bergland et al. 1994 ^H Pettigrew 1996, 1998 ^H Skinner 1995b ^I Wilson 1995

References Cited

- Ambroz, Jessica A.
1997 *Characterization of Archaeologically Significant Obsidian Sources in Oregon by Neutron Activation Analysis*. Unpublished Master's Thesis, Department of Chemistry, University of Missouri, Columbia, Missouri.
- Anttonen, Gary J.
1972 *Trace Elements in High Cascade Volcanic Rocks, Three Sisters Area, Oregon*. Unpublished Ph.D. Dissertation, Department of Geology, Stanford University, Palo Alto, California.
- Armitage, Charles L.
1995 *An Archaeological Analysis of Central Oregon Upland Prehistory*. Unpublished Ph.D. Dissertation, Department of Anthropology, University of Oregon, Eugene, Oregon.
- Bergland, Eric O., Jeffrey C. McAlister, and Christopher Stevenson
1994 *An Induced Hydration Rate for Obsidian Cliffs Glass*. In *Contributions to the Archaeology of Oregon: 1989-1994*, edited by Paul W. Baxter, pp. 1-13. Association for Oregon Archaeologists Occasional Papers No. 5, Eugene, Oregon.
- Carlson, Roy L.
1994 *Trade and Exchange in Prehistoric British Columbia*. In *Prehistoric Exchange Systems in North America*, edited by Timothy G. Baugh and Jonathon E. Ericson, pp. 307-361. Plenum Press, New York, New York.
- Connolly, Thomas J.
1999 *Newberry Crater: A Ten-Thousand-Year Record of Human Occupation and Environmental Change in the Basin-Plateau Borderlands*. University of Utah Anthropological Papers No. 121, Salt Lake City, Utah.
- Connolly, Thomas J. and R. Scott Byram
1999 *Obsidian Hydration Analysis*. In *Newberry Crater: A Ten-Thousand-Year Record of Human Occupation and Environmental Change in the Basin-Plateau Borderlands*, edited by Thomas J. Connolly, pp. 175-188. University of Utah Anthropological Papers No. 121, Salt Lake City, Utah.
- Endzweig, Pamela E.
1994 *Late Archaic Variability and Change on the Southern Columbia Plateau: Archaeological Investigations in the Pine Creek Drainage of the Middle John Day River, Wheeler County, Oregon*. Unpublished Ph.D. Dissertation, Department of Anthropology, University of Oregon, Eugene, Oregon.

Northwest Research Obsidian Studies Laboratory Report 2003-53

Flenniken, J. Jeffrey and Terry L. Ozbun

- 1988 *Archaeological Investigations in Newberry Crater, Deschutes National Forest, Central Oregon*. Report prepared for the Deschutes National Forest, Bend, Oregon, by Lithic Analysts, Pullman, Washington. Lithic Analysts Research Report No. 4.

Friedman, Irving

- 1977 Hydration Dating of Volcanism at Newberry Volcano, Oregon. *Journal of Research of the U. S. Geological Survey* 5:337-342.

Friedman, Irving and John Obradovich

- 1981 Obsidian Hydration Dating of Volcanic Events. *Quaternary Research* 16:37-47.

Hatch, John B.

- 1998 *Archaeological Investigation and Technological Analysis of the Quartz Mountain Obsidian Quarry, Central Oregon*. Unpublished Master's Thesis, Interdisciplinary Studies, Oregon State University, Corvallis, Oregon.

Hill, Brittain

- 1992 *Petrogenesis of Compositionally Distinct Silicic Volcanoes in the Three Sisters Region of the Oregon Cascade Range: The Effects of Crustal Extension on the Development of Continental Arc Silicic Magmatism*. Unpublished Ph.D. Dissertation, Department of Geology, Oregon State University, Corvallis, Oregon.

Hughes, Richard E.

- 1986 *Diachronic Variability in Obsidian Procurement Patterns in Northeast California and Southcentral Oregon*. University of California Publications in Anthropology 17, Berkeley, California.
- 1992 Appendix E: Report of X-Ray Fluorescence Analysis. In *An Archaeological Assessment of the Beech Creek Site (35LE415), Gifford Pinchot National Forest*. Gifford Pinchot National Forest, Vancouver, Washington.
- 1993 Trace Element Geochemistry of Volcanic Glass from the Obsidian Cliffs Flow, Three Sisters Wilderness, Oregon. *Northwest Science* 67(3):199-207.

Hughes, Richard E. and Pat Mikkelsen

- 1985 *X-Ray Fluorescence Analysis of Obsidian from Five Localities Along the Sycan and Sprague Rivers, Winema National Forest, Klamath County, Oregon*. Report prepared for the Winema National Forest, Contract No. 53-04U3-00069, Klamath Falls, Oregon.

Hughes, Scott S.

- 1983 *Petrochemical Evolution of High Cascade Volcanic Rocks in the Three Sisters Region, Oregon*. Unpublished Ph.D. Dissertation, Department of Geology, Oregon State University, Corvallis, Oregon.

LaLande, Jeff

- 1990 *Summary Report on the 1989 Obsidian-Sourcing Project*. Rogue River National Forest, Medford, Oregon.

Linneman, Scott R.

- 1990 *The Petrologic Evolution of the Holocene Magmatic System of Newberry Volcano, Central Oregon*. Unpublished Ph.D. Dissertation, Department of Geology and Geophysics, University of Wyoming, Laramie, Wyoming.

MacLeod, Norman S., David R. Sherrod, Lawrence A. Chitwood, and Robert A. Jensen

- 1995 *Geologic Map of Newberry Volcano, Deschutes, Klamath, and Lake Counties, Oregon*. U. S. Geological Survey Miscellaneous Investigations Series I-2455, scale 1:62,500 and 1:24,000.

Musil, Robert R. and Brian O'Neill

- 1997 Source and Distribution of Archaeological Obsidian in the Umpqua River Basin of Southwest Oregon. In *Contributions to the Archaeology of Oregon: 1995-1996*, edited by Albert Oetting, pp. 123-162. Association of Oregon Archaeologists Occasional Papers No. 6, Eugene, Oregon.

Northwest Research Obsidian Studies Laboratory

- 2003 Northwest Research Obsidian Studies Laboratory World Wide Web Site (www.obsidianlab.com).

Pettigrew, Richard M.

- 1996 Spatiotemporal Site Distribution Patterns in Eastern Oregon: Land Use Evidence from the Pipeline Expansion Project. Paper presented at the 49th Annual Northwest Anthropological Conference, Moscow, Idaho.

Northwest Research Obsidian Studies Laboratory Report 2003-53

- 1998 Obsidian Hydration Chronology in Eastern Oregon. Paper presented at the Society for American Archaeology Annual Meeting, Seattle, Washington.
- Skinner, Craig E.
- 1983 *Obsidian Studies in Oregon: An Introduction to Obsidian and An Investigation of Selected Methods of Obsidian Characterization Utilizing Obsidian Collected at Prehistoric Quarry Sites in Oregon*. Unpublished Master's Terminal Project, Interdisciplinary Studies, University of Oregon, Eugene, Oregon.
- 1986 *The Occurrence, Characterization, and Prehistoric Utilization of Geologic Sources of Obsidian in Central Western Oregon: Preliminary Research Results*. Unpublished manuscript on file at the Oregon State Museum of Anthropology, Eugene, Oregon.
- 1995a Obsidian Characterization Studies. In *Archaeological Investigations, PGT-PG&E Pipeline Expansion Project, Idaho, Washington, Oregon, and California, Volume V: Technical Studies*, by Robert U. Bryson, Craig E. Skinner, and Richard M. Pettigrew, pp. 4.1-4.54. Report prepared for Pacific Gas Transmission Company, Portland, Oregon, by INFOTEC Research Inc., Fresno, California, and Far Western Anthropological Research Group, Davis, California.
- 1995b Obsidian Sources Identified During PEP Studies. In *Archaeological Investigations, PGT-PG&E Pipeline Expansion Project, Idaho, Washington, Oregon, and California, Volume V: Technical Studies*, by Robert U. Bryson, Craig E. Skinner, and Richard M. Pettigrew, pp. C5.1-C5.11. Report prepared for Pacific Gas Transmission Company, Portland, Oregon, by INFOTEC Research, Inc., Fresno, California, and Far Western Anthropological Research Group, Davis, California.
- Skinner, Craig E. and Carol J. Winkler
- 1991 Prehistoric Trans-Cascade Procurement of Obsidian in Western Oregon: The Geochemical Evidence. *Current Archaeological Hoppenings in Oregon* 16(2):3-9.
- 1994 Prehistoric Trans-Cascade Procurement of Obsidian in Western Oregon: A Preliminary Look at the Geochemical Evidence. In *Contributions to the Archaeology of Oregon: 1989-1994*, edited by Paul Baxter, pp. 29-44. Association of Oregon Archaeologists Occasional Papers No. 5, Eugene, Oregon.
- South, Barry
- 1999 *Lithic Resource Procurement at Obsidian Cliffs, Oregon: A Comparative Study*. Unpublished Master's Thesis, Western Washington University, Bellingham, Washington.
- Taylor, Edward M.
- 1968 Roadside Geology: Santiam and McKenzie Pass Highways, Oregon. In *Andesite Conference Guidebook*, edited by H. Dole, pp. 3-33. Oregon Department of Geology and Mineral Industries Bulletin 62, Portland, Oregon.
- Taylor, Edward M., N. S. MacLeod, D. R. Sherrod, and G. W. Walker
- 1987 *Geologic Map of the Three Sisters Wilderness, Deschutes, Lane, and Linn Counties, Oregon*. U. S. Geological Survey Miscellaneous Field Studies Map MF-1952, scale 1:63,360.
- White, John R.
- 1974 *Prehistoric Sites of the Upper Willamette Valley: A Proposed Typology*. Unpublished Ph.D. Dissertation, Department of Anthropology, University of Oregon, Eugene, Oregon.
- 1975 The Hurd Site. In *Archaeological Studies in the Willamette Valley, Oregon*, edited by C. M. Aikens, pp. 141-225. University of Oregon Anthropological Papers No. 8, Eugene, Oregon.
- Williams, Howel
- 1935 Newberry Volcano of Central Oregon. *Geological Society of America Bulletin* 46:253-304.
- 1944 Volcanoes of the Three Sisters Region, Oregon Cascades. *University of California Publications in Geological Sciences*, 27:37-84.
- Wilson, Douglas
- 1995 Obsidian Procurement and Use in the Willamette Valley, Oregon. Unpublished manuscript in possession of the author.

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Table A-1. Results of XRF Studies: Redmond Caves Vicinity Sites, Deschutes County, Oregon

Site	Specimen No.	Catalog No.	Trace Element Concentrations											Ratios		Source
			Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	Fe ₂ O ₃ ^T	Fe:Mn	Fe:Ti	
(b) (3) Cultural Resources (NHPA & 54 CFR 101.12.6)	1	1-11932A	53 ± 8	24 4	149 4	65 9	43 3	290 7	17 1	NM NM	NM NM	NM NM	NM NM	56.7	45.9	(b) (3) Cultural Resources (NHPA & 54 CFR 101.12.6)
	2	1-11932B	48 ± 7	23 4	131 4	63 9	43 3	284 7	19 1	1450 77	339 46	NM NM	1.78 0.11	50.6	38.8	
	3	1-11932C	49 ± 8	12 5	121 4	58 9	39 3	266 7	17 1	NM NM	NM NM	NM NM	NM NM	51.2	48.9	
	4	1-11918D	49 ± 7	15 4	135 4	61 9	40 3	277 7	15 1	1295 77	410 46	NM NM	1.86 0.11	42.9	45.4	
	5	1-11932E	51 ± 7	19 4	130 4	66 9	42 3	275 7	15 1	1411 77	330 46	NM NM	1.93 0.11	56.4	43.1	
	6	1-11922F	67 ± 7	25 4	138 4	66 9	44 3	188 7	8 1	603 76	298 46	NM NM	1.59 0.11	52.5	83.7	
	7	1-11939G	61 ± 7	17 4	141 4	62 9	41 3	285 7	16 1	1283 77	414 46	NM NM	1.88 0.11	42.8	46.3	
	8	1-11939H	40 ± 7	22 4	142 4	61 9	41 3	282 7	18 1	1215 77	343 46	NM NM	1.59 0.11	45.2	41.7	
	9	1-11925I	53 ± 7	15 4	123 4	79 9	40 3	253 7	11 1	1249 77	310 46	984 NM	1.81 0.11	57.0	45.9	
	10	1-11932J	33 ± 7	14 4	77 4	103 9	17 3	94 7	8 1	410 75	209 46	NM NM	0.68 0.11	36.4	56.5	
	11	1-11925K	55 ± 7	22 4	129 4	78 9	39 3	258 7	12 1	1168 77	294 46	948 NM	1.55 0.11	52.2	42.3	
	12	1-11939L	48 ± 7	15 4	135 4	61 9	41 3	282 7	16 1	1273 77	375 46	NM NM	1.91 0.11	48.5	47.3	
	13	1-11918M	45 ± 7	16 4	141 4	61 9	40 3	280 7	17 1	1205 77	322 46	NM NM	1.77 0.11	53.5	46.6	
	14	1-11939N	55 ± 7	19 4	146 4	63 9	40 3	286 7	17 1	1362 77	370 46	NM NM	2.01 0.11	51.7	46.5	
	15	1-11939O	33 ± 7	11 4	80 4	110 9	16 3	98 7	6 1	536 76	300 46	NM NM	0.89 0.11	30.5	55.1	

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide. NA = Not available; ND = Not detected; NM = Not measured.; * = Small sample.

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Site	Specimen No.	Catalog No.	Trace Element Concentrations											Ratios		Source
			Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	Fe ₂ O ₃ ^T	Fe:Mn	Fe:Ti	
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	16	1-11938P	56 ± 7	20 4	139 4	59 9	44 3	285 7	16 1	1206 77	364 46	NM NM	1.81 0.11	47.5	47.3	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
	17	1-11923Q	47 ± 7	19 4	128 4	79 9	40 3	261 7	12 1	1152 77	325 46	963 NM	1.75 0.11	52.2	48.0	
	18	1-11924R	51 ± 7	15 4	137 4	58 9	43 3	288 7	19 1	1288 77	473 46	NM NM	1.90 0.11	37.3	46.4	
	19	1495 [redacted] S-1	64 ± 7	19 4	135 4	65 9	40 3	281 7	18 1	NM NM	NM NM	NM NM		61.2	38.9	
	20	1495 [redacted] S-1	59 ± 7	21 4	137 4	66 9	40 3	189 7	9 1	1204 77	323 46	NM NM	1.68 0.11	50.6	44.3	
	21	1495 [redacted] SO3	37 ± 7	17 4	126 4	78 9	41 3	257 7	12 1	1374 77	321 46	951 NM	1.86 0.11	56.4	42.8	
	22	1495 [redacted] SO4	40 ± 6	17 4	104 4	45 9	24 3	123 7	16 1	820 76	486 46	NM NM	0.69 0.11	14.2	28.5	
	23	1495 [redacted] SO5	23 ± 8	10 4	77 4	106 9	15 3	99 7	11 1	NM NM	NM NM	NM NM		37.3	36.5	
	24	[redacted] 2-1-1A	70 ± 8	19 5	172 4	70 9	42 3	215 7	11 2	769 76	180 45	NM NM	0.94 0.11	58.8	40.3	
	25	[redacted] 2-1-1B	67 ± 9	23 5	158 4	67 9	40 3	204 7	12 2	536 75	174 45	NM NM	0.74 0.11	49.6	46.7	
	26	[redacted] 2-2-1A	49 ± 8	22 4	152 4	63 9	41 3	208 7	11 1	896 76	222 46	NM NM	1.25 0.11	59.1	45.0	
	27	[redacted] 2-2-1B	55 ± 7	16 4	131 4	58 9	37 3	200 7	11 1	1379 77	280 46	NM NM	1.65 0.11	58.5	38.0	
	28	[redacted] 2-3-1A	27 ± 8	11 4	89 4	120 9	16 3	104 7	7 1	464 75	239 46	NM NM	0.76 0.11	34.6	55.5	
	29	[redacted] 2-3-1B	55 ± 8	22 4	154 4	71 9	47 3	298 7	20 1	NM NM	NM NM	NM NM		55.7	47.1	
	30	[redacted] 2-3-1C	45 ± 7	18 4	140 4	60 9	38 3	204 7	10 1	703 76	234 46	NM NM	1.17 0.11	52.5	54.1	

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
 NA = Not available; ND = Not detected; NM = Not measured.; * = Small sample.

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Table A-1. Results of XRF Studies: Redmond Caves Vicinity Sites, Deschutes County, Oregon

Site	Specimen		Trace Element Concentrations											Ratios		Source
	No.	Catalog No.	Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	Fe ₂ O ₃ ^T	Fe:Mn	Fe:Ti	
(b) (5) Cultural Resources	31	2-3-1D	36	43	151	61	41	206	13	925	240	NM	1.32	56.5	45.8	(b) (5) Cultural Resources (ARPA & Sec. 204, NRPA)
			± 7	4	4	9	3	7	1	76	46	NM	0.11			
	32	2-3-1E	39	17	140	60	39	201	13	928	344	NM	1.46	41.3	50.3	
			± 7	4	4	9	3	7	1	77	46	NM	0.11			
	33	2-3-1F	61	28	165	68	43	217	12	1047	400	NM	1.69	40.2	51.3	
			± 7	4	4	9	3	7	1	77	46	NM	0.11			
	34	2-3-1G	53	24	138	61	40	203	12	923	341	NM	1.50	42.9	52.0	
			± 7	4	4	9	3	7	1	77	46	NM	0.11			
	35	2-3-1H	49	26	160	68	44	209	12	571	178	NM	0.93	59.0	53.6	
			± 8	4	4	9	3	7	1	76	46	NM	0.11			
	36	2-4-2A	43	26	155	65	38	206	11	976	269	NM	1.53	57.1	49.9	
			± 7	4	4	9	3	7	1	77	46	NM	0.11			
	37	2-4-2B	62	26	170	72	44	221	12	672	207	NM	1.07	56.1	52.2	
			± 8	4	4	9	3	7	1	76	46	NM	0.11			
	38	2-5-1	51	25	152	62	41	212	12	822	245	NM	1.27	53.7	50.0	
			± 7	4	4	9	3	7	1	76	46	NM	0.11			
	39	1-1-1A	40	19	132	57	38	201	12	853	207	NM	1.10	57.0	41.9	
			± 8	5	4	9	3	7	1	76	46	NM	0.11			
	40	1-1-1B	54	21	133	58	38	203	10	1266	266	NM	1.54	58.3	38.8	
			± 8	4	4	9	3	7	1	77	46	NM	0.11			
	41	1-1-1C	38	19	133	63	39	207	11	1427	264	NM	1.61	61.2	35.8	
			± 8	4	4	9	3	7	1	78	46	NM	0.11			
	42	1-2-1A	57	23	148	63	38	210	11	965	225	NM	1.23	57.3	41.1	
			± 7	4	4	9	3	7	1	76	46	NM	0.11			
	43	1-2-1B	55	21	165	70	42	216	11	NM	NM	NM	NM	53.8	46.6	
			± 9	5	4	9	3	7	2	NM	NM	NM	NM			
	44	1-3-1A	54	41	137	57	39	197	11	1168	257	NM	1.48	58.4	40.5	
			± 7	4	4	9	3	7	1	77	46	NM	0.11			
	45	1-3-1B	35	19	143	64	41	208	13	NM	NM	NM	NM	63.3	43.8	
			± 8	4	4	9	3	7	1	NM	NM	NM	NM			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide. NA = Not available; ND = Not detected; NM = Not measured.; * = Small sample.

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Site	Specimen		Trace Element Concentrations											Ratios		Source
	No.	Catalog No.	Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	Fe ₂ O ₃ ^T	Fe:Mn	Fe:Ti	
NA	46	RGM-1	41	23	149	63	39	205	11	NM	NM	NM	NM	62.5	31.9	RGM-1 Reference Standard
			± 8	4	4	9	3	7	1	NM	NM	NM	NM			
	47		52	22	147	61	44	214	11	789	208	NM	1.17	60.1	48.0	
			± 7	4	4	9	3	7	1	76	46	NM	0.11			
	48		34	23	129	59	37	200	12	1495	279	NM	1.65	58.8	35.0	
			± 8	4	4	9	3	7	1	78	46	NM	0.11			
	49		57	16	151	65	41	213	9	1062	221	NM	1.24	59.1	37.7	
			± 7	4	4	9	3	7	1	77	46	NM	0.11			
	50		55	24	138	63	38	208	12	1518	259	NM	1.61	62.7	33.8	
			± 7	4	4	9	3	7	1	78	46	NM	0.11			
	51		46	15	134	61	38	205	10	929	220	NM	1.25	60.0	43.6	
			± 7	4	4	9	3	7	1	76	46	NM	0.11			
	52		45	21	156	65	41	216	10	696	178	NM	0.86	55.1	41.2	
			± 8	4	4	9	3	7	1	76	45	NM	0.11			
	53		47	22	142	60	37	205	12	NM	NM	NM	NM	60.9	55.2	
			± 7	4	4	9	3	7	1	NM	NM	NM	NM			
NA	RGM-1	RGM-1	33	25	155	104	26	225	10	1596	342	NM	1.80	50.8	35.7	RGM-1 Reference Standard
			± 7	4	4	9	3	7	1	77	46	NM	0.11			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
 NA = Not available; ND = Not detected; NM = Not measured.; * = Small sample.

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Table B-1. Obsidian Hydration Results and Sample Provenience: Redmond Caves Vicinity Sites, Deschutes County, Oregon

Site	Specimen		Unit	Depth	Type ^A	Source	Hydration Rims		Comments ^B
	No.	Catalog No.					Rim 1	Rim 2	
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	1	1-11932A	--	--	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	NA ± NA	NM ± NM	UNR (crystalline)
	2	1-11932B	--	--			2.2 ± 0.0	NM ± NM	--
	3	1-11932C	--	--			2.1 ± 0.1	NM ± NM	Same rim on BRE
	4	1-11918D	--	--			2.6 ± 0.1	NM ± NM	WEA
	5	1-11932E	--	--			3.2 ± 0.1	NM ± NM	--
	6	1-11922F	--	--			2.0 ± 0.1	NM ± NM	--
	7	1-11939G	--	--			2.4 ± 0.1	NM ± NM	Same rim on BRE
	8	1-11939H	--	--			2.1 ± 0.0	NM ± NM	--
	9	1-11925I	--	--			2.6 ± 0.1	NM ± NM	Same rim on BRE
	10	1-11932J	--	--			2.2 ± 0.1	NM ± NM	Same rim on BRE
	11	1-11925K	--	--			2.1 ± 0.1	NM ± NM	Same rim on BRE
	12	1-11939L	--	--			2.0 ± 0.1	NM ± NM	Same rim on BRE
	13	1-11918M	--	--			2.0 ± 0.1	NM ± NM	Same rim on BRE
	14	1-11939N	--	--			2.1 ± 0.1	NM ± NM	--
	15	1-11939O	--	--			2.0 ± 0.1	NM ± NM	--
	16	1-11938P	--	--			2.1 ± 0.1	NM ± NM	DFV
	17	1-11923Q	--	--			2.4 ± 0.1	NM ± NM	--
	18	1-11924R	--	--			3.1 ± 0.1	NM ± NM	--
	19	1495-RC1-S-1	--	--			NM ± NM	NM ± NM	--
	20	1495-RC7-S-1	--	--			NM ± NM	NM ± NM	--
	21	1495-RC-ISO3	--	--			NM ± NM	NM ± NM	--
	22	1495-RC-ISO4	--	--			NM ± NM	NM ± NM	--
	23	1495-RC-ISO5	--	--			NM ± NM	NM ± NM	--

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

^B See text for explanation of comment abbreviations

NA = Not Available; NM = Not Measured; * = Small sample

Northwest Research Obsidian Studies Laboratory

Table B-1. Obsidian Hydration Results and Sample Provenience: Redmond Caves Vicinity Sites, Deschutes County, Oregon

Site	Specimen		Unit	Depth	Type ^A	Source	Hydration Rims		Comments ^B
	No.	Catalog No.					Rim 1	Rim 2	
(b) (3) Cultural Resources	24	-2-1-1A	TP 2	0-10	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	NA ± NA	NM ± NM	UNR
	25	-2-1-1B	TP 2	0-10			NA ± NA	NM ± NM	UNR
	26	-2-2-1A	TP 2	10-20			NA ± NA	NM ± NM	UNR; approx. 5.4 microns
	27	-2-2-1B	TP 2	10-20			4.8 ± 0.1	NM ± NM	DFV
	28	-2-3-1A	TP 2	20-30			3.1 ± 0.1	NM ± NM	--
	29	-2-3-1B	TP 2	20-30			3.2 ± 0.1	NM ± NM	--
	30	-2-3-1C	TP 2	20-30			5.4 ± 0.1	NM ± NM	--
	31	-2-3-1D	TP 2	20-30			4.9 ± 0.1	NM ± NM	PAT; DFV
	32	-2-3-1E	TP 2	20-30			NA ± NA	NM ± NM	UNR
	33	-2-3-1F	TP 2	20-30			5.1 ± 0.1	NM ± NM	PAT; DFV
	34	-2-3-1G	TP 2	20-30			5.4 ± 0.1	NM ± NM	--
	35	-2-3-1H	TP 2	20-30			5.1 ± 0.1	NM ± NM	--
	36	-2-4-2A	TP 2	30-40			5.2 ± 0.0	NM ± NM	DFV
	37	-2-4-2B	TP 2	30-40			5.0 ± 0.1	NM ± NM	--
	38	-2-5-1	TP 2	40-50			5.0 ± 0.1	NM ± NM	--
	39	-1-1-1A	TP 1	0-5			NA ± NA	NM ± NM	UNR
	40	-1-1-1B	TP 1	0-5			NA ± NA	NM ± NM	UNR
	41	-1-1-1C	TP 1	0-5			NA ± NA	NM ± NM	UNR
	42	-1-2-1A	TP 1	5-10			NA ± NA	NM ± NM	UNR
	43	-1-2-1B	TP 1	5-10			NA ± NA	NM ± NM	UNR
	44	-1-3-1A	TP 1	0-15			NA ± NA	NM ± NM	UNR
	45	-1-3-1B	TP 1	0-15			NA ± NA	NM ± NM	UNR
	46	-1-4-1A	TP 1	15-20			NA ± NA	NM ± NM	PAT; NVH

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

^B See text for explanation of comment abbreviations

NA = Not Available; NM = Not Measured; * = Small sample

Northwest Research Obsidian Studies Laboratory

Table B-1. Obsidian Hydration Results and Sample Provenience: Redmond Caves Vicinity Sites, Deschutes County, Oregon

Site	Specimen		Unit	Depth	Type ^A	Source	Hydration Rims		Comments ^B
	No.	Catalog No.					Rim 1	Rim 2	
	47	1-4-1B	TP 1	15-20			NA ± NA	NM ± NM	PAT; UNR
	48	2-1-1A	TP 2	0-5			NA ± NA	NM ± NM	UNR
	49	2-1-1B	TP 2	0-5			NA ± NA	NM ± NM	UNR; approx. 5.2 microns
	50	2-1-1C	TP 2	0-5			NA ± NA	NM ± NM	PAT; NVH
	51	2-2-1A	TP 2	5-10			NA ± NA	NM ± NM	NVH
	52	2-2-1B	TP 2	5-10			NA ± NA	NM ± NM	UNR; approx. 5.2 microns
	53	2-3-1	TP 2	10-15			5.3 ± 0.1	NM ± NM	DFV

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

^B See text for explanation of comment abbreviations

NA – Not Available; NM = Not Measured; * = Small sample

Abbreviations and Definitions Used in the Comments Column

All hydration rim measurements are recorded in microns.

BEV - (Beveled). Artifact morphology or cut configuration resulted in a beveled thin section edge.

BRE - (BREak). The thin section cut was made across a broken edge of the artifact. Resulting hydration measurements may reveal when the artifact was broken, relative to its time of manufacture.

DES - (DEStroyed). The artifact or flake was destroyed in the process of thin section preparation. This sometimes occurs during the preparation of extremely small items, such as pressure flakes.

DFV - (Diffusion Front Vague). The diffusion front, or the visual boundary between hydrated and unhydrated portions of the specimen, are poorly defined. This can result in less precise measurements than can be obtained from sharply demarcated diffusion fronts. The technician must often estimate the hydration boundary because a vague diffusion front often appears as a relatively thick, dark line or a gradation in color or brightness between hydrated and unhydrated layers.

DIS - (DIScontinuous). A discontinuous or interrupted hydration rind was observed on the thin section.

HV - (Highly Variable). The hydration rind exhibits variable thickness along continuous surfaces. This variability can occur with very well- defined bands as well as those with irregular or vague diffusion fronts.

IRR - (IRRegular). The surfaces of the thin section (the outer surfaces of the artifact) are uneven and measurement is difficult.

ISO - (1 Surface Only). Hydration was observed on only one surface or side of the thin section.

NOT - (NOT obsidian). Petrographic characteristics of the artifact or obsidian specimen indicate that the specimen is not obsidian.

NVH - (No Visible Hydration). No hydration rind was observed on one or more surfaces of the specimen. This does not mean that hydration is absent, only that hydration was not observed. Hydration rinds smaller than one micron often are not birefringent and thus cannot be seen by optical microscopy. "NVH" may be reported for the manufacture surface of a tool while a hydration measurement is reported for another surface, e.g. a remnant ventral flake surface.

OPA - (OPAque). The specimen is too opaque for measurement and cannot be further reduced in thickness.

PAT - (PATinated). This description is usually noted when there is a problem in measuring the thickness of the hydration rind, and refers to the unmagnified surface characteristics of the artifact, possibly indicating the source of the measurement problem. Only extreme patination is normally noted.

REC - (RECut). More than one thin section was prepared from an archaeological specimen. Multiple thin sections are made if preparation quality on the initial specimen is suspect or obviously poor. Additional thin sections may also be prepared if it is perceived that more information concerning an artifact's manufacture or use can be obtained.

UNR - (UNReadable). The optical quality of the hydration rind is so poor that accurate measurement is not possible. Poor thin section preparation is not a cause.

WEA - (WEAthered). The artifact surface appears to be damaged by wind erosion or other mechanical action.

REDMOND CAVES
ARCHAEOLOGICAL PROJECT
An Interim Report: Spring 2004

Compiled and Edited

by

Margaret M. Helzer

With contributions by

Kimberly Bowker

Mary Conroy

Erin Fourier

Jessica Henry

State Museum of Anthropology
University of Oregon

2004

How your team field school should proceed or surface investigations of
newly recovered surface site testing criteria the entire
to area. continued mapping & cave initiations.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Site

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

28, 50 X 50cm

probes were located at the site that (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

* Testing revealed that the site lacked potential to yield significant
information, deeming further archaeological investigations at the site
unnecessary.

Entrance to Cave

1, 50X50cm probe & 1 1X1meter test pit on opposite sides of the same
entrance. The 50X50 cm probe was excavated to a depth of 70cm, the
1X1m test pit to a depth of 120cm.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Obsidian Sourcing

Locations of Obsidian sources were the same as previous reports with the
exception of one additional source

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Debitage Analysis - Results from debitage analysis of 16

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

*** Investigation efforts during this field school bring the total
number of sites discovered & evaluated outside the caves to 8. In
addition, the collective field school efforts have resulted in the
documentation of 7 isolated finds.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

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Comments:

- pg. 4 Typo - 8 2003
- pg. 8 No cave mapping was conducted as noted in "goals for Spring 2004"
- pg. 20 Cave [REDACTED] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) Is this Hezins 1941 site? [REDACTED] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) refers to it as
- pg. 22 The caption under the picture of the [REDACTED] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) a [REDACTED] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
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What is its eligibility status?

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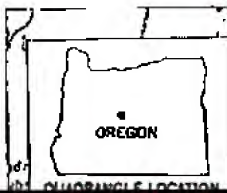
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CHAPTER 1: INTRODUCTION

This document represents the fourth interim report of a multi-year project that involves archaeological investigations of a [REDACTED] parcel of public land administered by the Bureau of Land Management and located [REDACTED] of Redmond, Oregon (Figures 1.1 and 1.2). The Bureau of Land Management and the City of Redmond have entered into a collaborative agreement to manage the parcel as a public park. Currently undeveloped, the parcel contains five lava tube caves and a network of unmaintained dirt roads for access. Archaeological resources are known to exist both inside and outside of the caves (Fagan 1998, Helzer 2004; 2003; 2002). The caves, along with the natural vegetation, draw the interest of local hikers, bird watchers, rock collectors, and nature lovers. A managed park should encourage more of this type of public use and discourage unwanted activities, such as vandalism and trash dumping.



Figure 1.1. View of Redmond Cave [REDACTED] view to the north.



(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Figure 1.2. Location of Redmond Caves Project Area.

The archaeological investigations required under federal laws before the proposed development takes place are being conducted by the State Museum of Anthropology in conjunction with the UO Field Studies Center in Bend. Previous archaeological studies at the Redmond Caves parcel include excavations in two caves, conducted by Robert Heizer in 1941, and a reconnaissance survey conducted by Archaeological Investigations Northwest (AINW) for the Redmond Caves Master Plan (Fagan 1998).

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



Figure 1.3. Proposed development for the Redmond Caves Project (Master Plan 1998).

The Redmond Caves Archaeological Project is conceived of as a multi-year program designed to identify and evaluate the archaeological resources found within the [REDACTED] parcel. The investigations will be conducted as part of a University of Oregon class entitled "Field Studies in Archaeology" (ANTH 408), which meets fall and spring terms and is offered through the UO Field Studies Center in Bend, Oregon. This work will guide planning by designating areas where visitor enhancements might be made without damaging cultural resources, by identifying measures for protecting significant resources, and by developing a body of knowledge on the nature of archaeological resources for public interpretation and education.

As the Redmond Caves Archaeological Project will be on-going (i.e., conducted in separate phases over several years), this report provides a summary of the work conducted by the University of Oregon Fieldwork in Archaeology class for spring term, 2006. Work during this phase of the project was focused on subsurface probing of a newly discovered site outside the caves and testing outside the mouth of Cave [REDACTED] (Figure 1.4). Obsidian hydration and sourcing were also conducted on collected [REDACTED] and are represented in the current report.



Figure 1.4. University of Oregon students working in the field at Redmond Caves Parcel.

CHAPTER 2: BACKGROUND AND PREVIOUS ARCHAEOLOGICAL WORK

The Redmond Caves (b) (3) Cultural Resources BLM parcel lies within the northwestern area of the High Lava Plains, in close proximity to the Deschutes River Basin and on the southern extension of the Columbia Basin physiographic province (Figure 2.1). This region also represents a zone of cultural transition between the southern Columbia Plateau and the northern Great Basin. Redmond Caves, and the associated sites outside the caves, are located in the heart of this cultural and geographic transition zone and most likely will reflect these cultural uses and patterns observed from ethnographic and archaeological records.

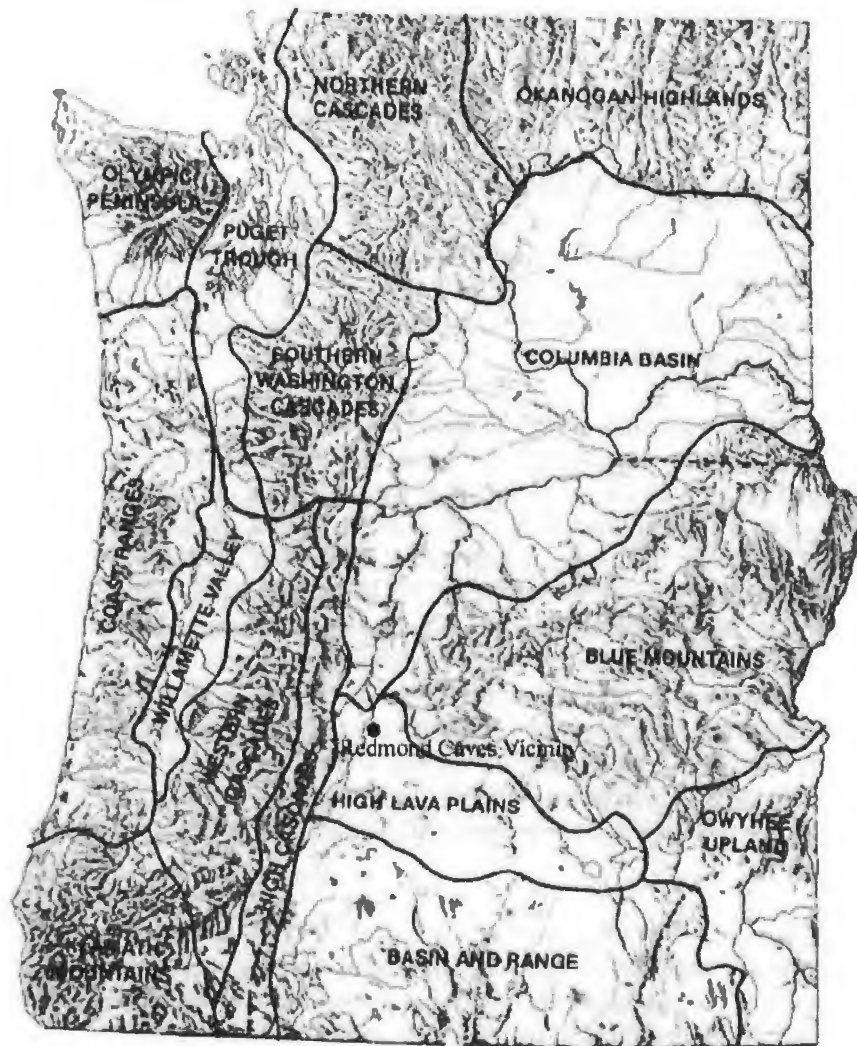


Figure 2.1. Physiographic and geologic provinces of Oregon and Washington, showing location of Redmond Caves vicinity. (Franklin and Dyrness 1988).

The area can be characterized as a semi-arid zone with a continental temperature regime and it is heavily influenced by the Cascade Range. The plain slopes gradually to the north as part of the Deschutes River drainage and is one of the southern portions of the greater Columbia River Plateau (Franklin and Dyrness 1988). Most secondary streams in the area are ephemeral because of scant precipitation and porous bedrock. Summers are hot and dry. Average annual precipitation in the area is 12 inches. The porous volcanic structure of much of the drainage allows precipitation to percolate downward into the substrata and emerges as springs, thus providing a relatively constant source of water, giving the Deschutes a semi-consistent flow of water (Lebow et al. 1990). Elevation of the Redmond Caves averages 3,050 ft.

Vegetation of the parcel consists primarily of scattered juniper (*Juniperus occidentalis*), sagebrush (*Artemisia tridentata*), and rabbitbrush (*Chrysothamnus nauseosus*). [REDACTED] plants such as Great Basin wild rye (*Elymus cinereus*), biscuit root (*Lomatium canbyi*), and sand lily (*Leucocrinum montanum*) were observed in the area this spring.

2002-2004 Archaeological Investigations

The University of Oregon Fieldwork in Archaeology class began investigations at the Redmond Caves parcel in the fall of 2002. Of particular focus during that term was a pedestrian survey of the [REDACTED] parcel, the mapping of sites and isolated finds, subsurface testing in the area of the proposed parking lot and visitors center, subsurface testing in one site, analysis of collected [REDACTED] review of archaeological work previously conducted, and analysis of [REDACTED] collected in the caves by Robert Heizer in 1941.

Archaeological investigations at the Redmond Caves parcel for fall term 2002 included a pedestrian survey (in which sites and isolated finds were identified and mapped), subsurface testing in the proposed parking lot area, subsurface testing in site [REDACTED] and analysis of [REDACTED] recovered from the caves by Robert Heizer in 1941. The survey was conducted by walking north-south transects at 5 meter intervals. A total of seven sites [REDACTED]

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

[REDACTED] and seven isolates outside the caves were recorded and mapped (Figure 2.2). [REDACTED]

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

[REDACTED] The temporary site numbers [REDACTED] were given to the sites identified in fall 2002. Subsequently, trinomial site numbers have been issued by the State Historic Preservation Office in Salem, Oregon. Although there are several references to the temporary site names, the permanent site numbers will be the primary designation used to discuss the sites in this report.

Six 50x50 cm probes were excavated in site [REDACTED] to determine the nature and depth of archaeological deposits at this location. The sediment consisted primarily of loose volcanic ash; no significant stratigraphic changes were observed. [REDACTED]

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Twenty 50x50 cm probes were excavated in the location of the proposed parking lot and visitors' center. No archaeological resources were encountered on the surface during survey, and no cultural remains were identified in the subsurface testing.

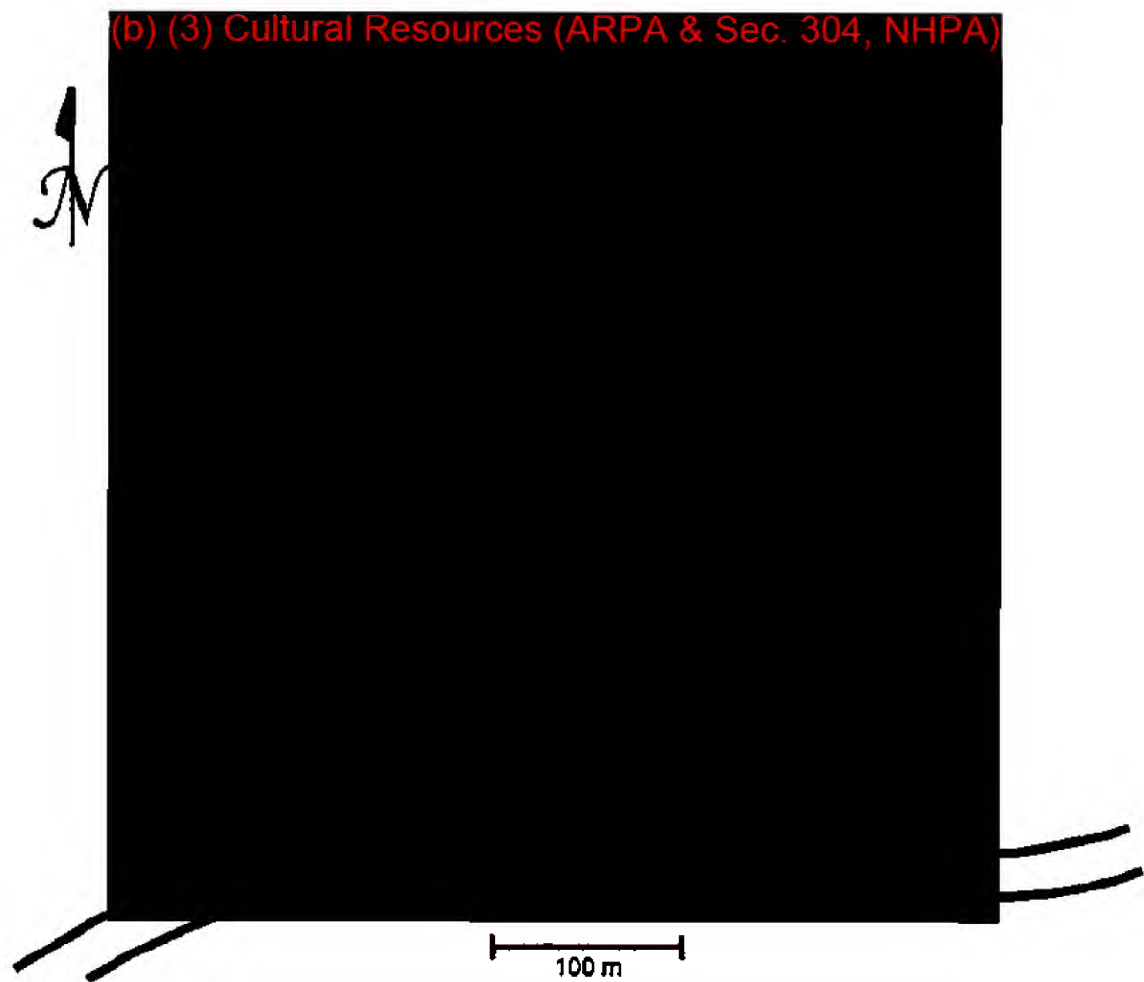


Figure 2.2. Sketch map of Redmond Caves Parcel; sites and isolates identified fall 2002. Site size not to scale.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) from Redmond Caves excavated by Robert Heizer in 1941, which are housed at the Oregon State Museum of Natural History, were analyzed by students during the fall term.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) While the diversity of (b) (3) Cultural Resources recovered from within the caves by Heizer (1941) point to multi-use activities, further investigations continue in order to better assess the archaeological components both within the caves and in the sites recorded outside the caves.

CHAPTER 3: FIELDWORK

University of Oregon students conducted fieldwork at the Redmond Caves parcel during the spring term of 2004. A previously unrecorded site [REDACTED] was identified and investigated for subsurface deposits and site boundaries. Testing at the mouth of Cave [REDACTED] suggests that [REDACTED] deposits in and near the caves are substantially deeper than deposits associated with sites outside the caves.

Awaiting State Trinomial Designation)

Site [REDACTED] is located along a main roadway of the Redmond Caves BLM parcel that runs in a north-south direction near the mouths of Caves [REDACTED] (Figure 3.1). The site had not been previously identified during recent investigations at the parcel. Students of the spring 2004 class discovered the site while casually walking along the road on the first day of field investigations. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) (Figures 3.2-3.4).

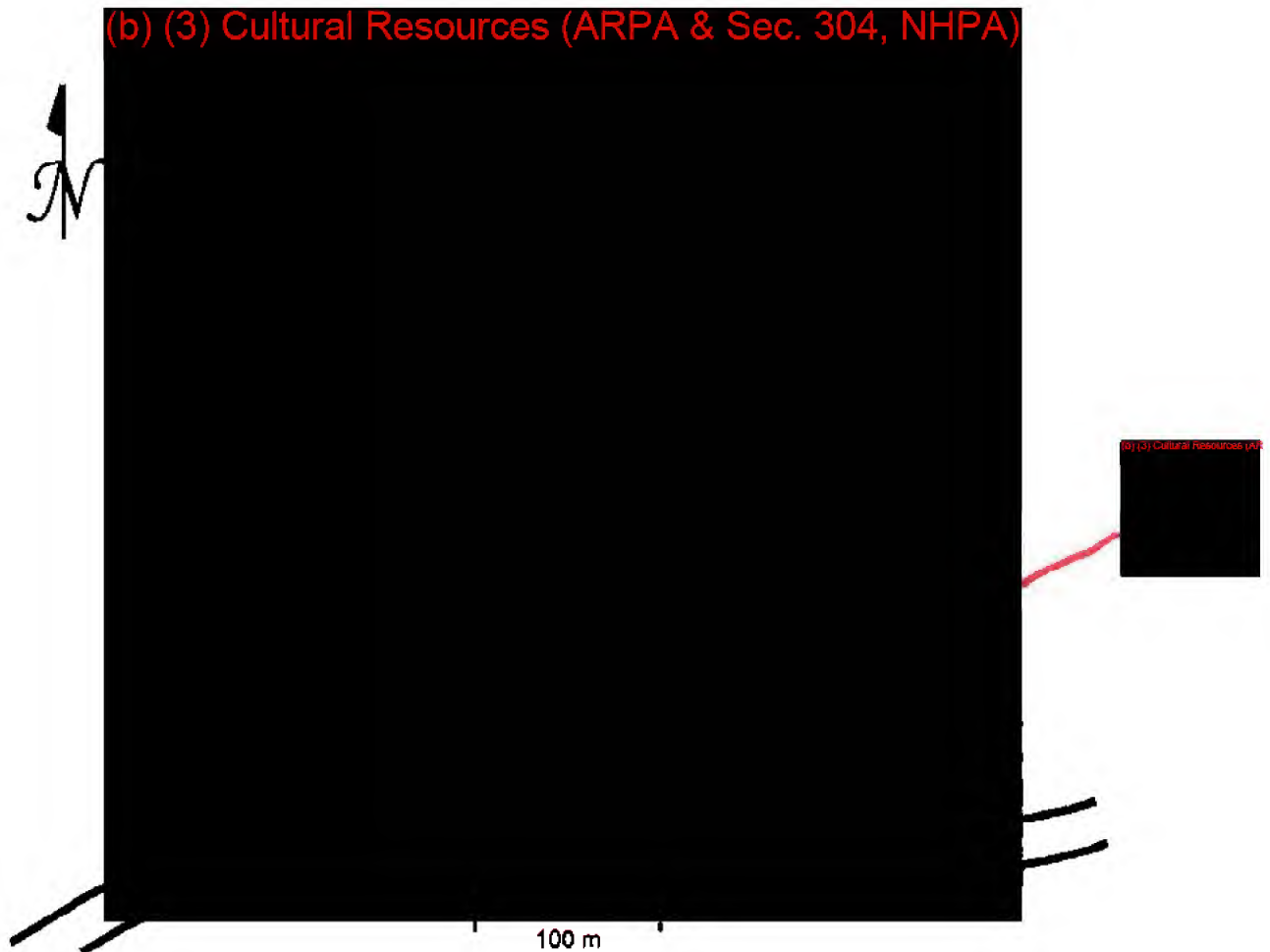


Figure 3.1. Map of Redmond Caves parcel, showing site locations.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



Figure 3.2. [redacted] 1 cm from [redacted] 1571 [redacted]-S-2).

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



Figure 3.3. [redacted]
from [redacted] (1571-[redacted]-S-1).

Figure 3.4. [redacted]
from [redacted] (1571-[redacted]-S-3).

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

The site encompasses an area of 1060 sq. meters, including the road which is extremely compacted from vehicle use and where bedrock is extruding on the surface in several places. Vegetation at the site is consistent with that observed at other sites on the parcel, specifically low sagebrush, grasses, and a few scattered juniper trees. Ground visibility at the site was good given the sparse vegetation and sandy surface (Figure 3.6).

Probes were initially spaced at 10 meter intervals in order to assess the archaeological deposits below the surface. Further probing at 5 meter intervals was conducted in areas where [REDACTED] were present and there was a need to collect more data for a more thorough understanding of the [REDACTED] deposits in that location. A total of 28 probes measuring 50x50 cm were dug. **(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)**
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) No cultural features were identified at the site.

Results from the probes excavated in [REDACTED] are presented in Table 3.1. **(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)** These excavation units include Probes 1, 3, 4, 5, 6, 8, 9, 12, 13, 14, 15, 17, 18, and 20 (Figure 3.5). **(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)**
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

The northern edge of [REDACTED] is located approximately 40 meters from the mouth of Cave [REDACTED]. Probes 10, 26, 27, and 28 were excavated in order to assess whether the [REDACTED] deposits in [REDACTED] could be characterized as [REDACTED] dispersing from the cave itself. **(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)**

No further archaeological investigations are recommended at [REDACTED]

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)




Figure 3.5. Sketch map of  showing locations of probes.
Positive probes are shown in red.



Figure 3.6. View to the north of [REDACTED] showing locations of [REDACTED] on the surface along edge of road.

Table 3.1. Results of Probes from [REDACTED]

Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
1	1	
	2	
	3	
	Total	
	Reason for termination: bedrock	
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
2	1	
	2	
	3	
	4	
	5	
	Total	
Reason for termination: (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) sterile		
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
3	1	
	Total	
Reason for termination: bedrock		

Table 3.1 (cont.). Results of Probes from

Probe	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
4		
Reason for termination: bedrock		
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
5	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	Total	
Reason for termination: two sterile levels		
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
6	1	
	2	
	3	
	4	
	5	
	6	
	Total	
	Reason for termination: two sterile levels	
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
8	1	
	2	
	3	
	4	
	5	
	Total	
	Reason for termination: two sterile levels	
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
9	1	
	2	
	3	
	4	
	5	
	Total	
Reason for termination: two sterile levels		

Table 3.1 (cont.). Results of Probes from (b) (3) Cultural Resources

Probe	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
10		
	Reason for termination:	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) sterile
Probe	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
11		
	Reason for termination:	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) sterile
Probe	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
12		
	Reason for termination: bedrock	
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
13	1	
	2	
	3	
	4	
	Total	
	Reason for termination: bedrock	
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
14	1	
	2	
	3	
	Total	
	Reason for termination: two sterile levels	
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
15	1	
	2	
	3	
	4	
	Total	
	Reason for termination: three sterile levels	

Table 3.1 (cont.). Results of Probes from

Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
16	1		
	2		
	Total		
	Reason for termination: (b) (3) Cultural Resources sterile		
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
17	1		
	Total		
	Reason for termination: bedrock		
	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)		
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
18	1		
	2		
	3		
	Total		
	Reason for termination: two sterile levels		
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
19	1		
	2		
	3		
	Total		
	Reason for termination: (b) (3) Cultural Resources sterile		
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
20	1		
	2		
	3		
	Total		
	Reason for termination: two sterile levels		
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
21	1		
	2		
	Total		
	Reason for termination: bedrock		
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
22	1		
	2		
	Total		
	Reason for termination: bedrock		

Table 3.1 (cont.). Results of Probes from

Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
23	1	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
	2	
	3	
	Total	
	Reason for termination:	sterile
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
24	1	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
	2	
	3	
	Total	
	Reason for termination:	sterile
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
25	1	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
	2	
	Total	
	Reason for termination:	bedrock
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
26	1	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
	2	
	2	
	Total	
	Reason for termination:	sterile
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
27	1	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
	2	
	3	
	Total	
	Reason for termination:	sterile
Probe	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
28	1	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
	2	
	3	
	Total	
	Reason for termination:	sterile

Cave

(b) (3) Cultural Resources (ARPA)

- Heizer's 1941 site?

Spring term excavations at the mouth of Cave began with two 50x50 cm probes placed on either side of the main path descending into the depression in front of the cave. Probe 1 was excavated to a depth of 70 cm and was terminated due to rock encroachment.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) Table 3.2).

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) Results from Probe 2 were combined with the test pit and are shown in Table 3.3.

Table 3.2. Results from Cave Probe 1.

Unit	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
Cave Probe 1 (50x50 cm)	1	
	2	
	3	
	4	
	5	
	6	
	7	
	Total	

Table 3.3. Results from Cave Test Pit 1 (includes results from Probe 2).

Unit	Level	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
Cave Test Pit 1	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	Total	



Figure 3.7. UO students excavating Cave TP1, view to the north.



Figure 3.8. UO students excavating Cave TP1, view to the west.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

No major stratigraphic changes were encountered through the deposits, and modern trash was not evident in the unit below about 30-40 cm. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

the
sketch, factor 6
a?

Figure 3.9.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

from Cave

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Test Pit 1 (1571-

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

1-4-1).

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Figure 3.10.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

from Cave

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Test Pit 1 (1571-

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

1-9-1).

according to the above text,

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

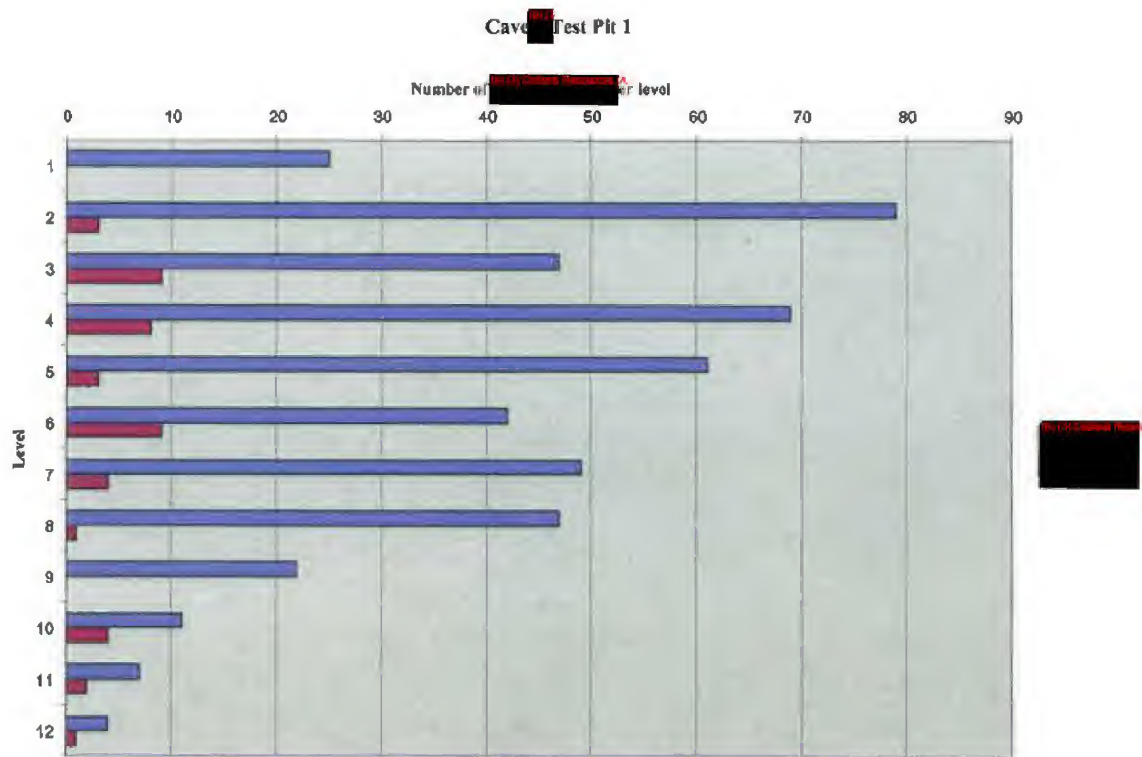


Figure 3.11. Chart showing the frequency of [redacted] in Cave [redacted] Unit 1.

CHAPTER 4: SPECIAL STUDIES

[REDACTED] from the Redmond Caves Archaeological Project have been subjected to a variety of analytical studies in order to enhance our understanding of the [REDACTED] deposits in the area. These studies include obsidian sourcing, obsidian hydration, and debitage analysis. An overview of these special studies and the current results are presented below.

Obsidian Sourcing

Obsidian, a common toolstone utilized by indigenous people in the west, has the potential to provide archaeologists with valuable insights regarding procurement strategies, migration, and trade. The analytical technique of X-ray fluorescence measures the trace element characteristics in obsidian specimens, making it possible to identify the parent source from which the stone originated. Skinner (2002) notes that while most obsidian sources are quite homogenous, the composition of trace elements in obsidian varies from source to source. Therefore, if the trace elements of a geologic source are known, obsidian artifacts recovered from archaeological sites can be correlated with known sources.

[REDACTED] obsidian specimens were selected for X-ray fluorescence analysis (XRF) and sent to Northwest Research Laboratory in Corvallis, Oregon in the spring of 2003. The samples were sent off for analysis in two separate shipments. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Seven geochemical source groups, six of which were correlated with known geologic sources, were identified among the [REDACTED] specimens from the Redmond Caves site (Figure 4.1, Table 4.2). (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) See Figure 4.2 for a

map of the location of these sources in relation to the Redmond Caves. The most predominant geologic source for obsidian [REDACTED] from the Redmond Caves Archaeological Project is

[REDACTED] represented by 60% of the specimens. The second most predominant source is [REDACTED] at 21%. The remaining four sources range between 1% and 9% of the sample (Figure 4.1).

This is a new location for this report

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Table 4.1. Redmond Caves (b) (3) Cultural Resources submitted for obsidian analysis to date.

Specimen No.	Description	Comments	Source	Rim Results
Site: (b) (3) Cultural Resources (ARPA)				
(Heizer)	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)		(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	
1-11932 A		Heizer Collection		NM± NM
1-11932 B		Heizer Collection		2.2± 0.0
1-11932 C		Heizer Collection		2.1± 0.1
1-11918 D		Heizer Collection		2.6± 0.1
1-11932 E		Heizer Collection		3.2± 0.1
1-11922 F		Heizer Collection		2.0± 0.1
1-11939 G		Heizer Collection		2.4± 0.1
1-11939 H		Heizer Collection		2.1± 0.0
1-11925 I		Heizer Collection		2.6± 0.1
1-11932 J		Heizer Collection		2.2± 0.1
1-11925 K		Heizer Collection		2.1± 0.1
1-11939 L		Heizer Collection		2.0± 0.1
1-11918 M		Heizer Collection		2.0± 0.1
1-11939 N		Heizer Collection		2.1± 0.1
1-11939 O		Heizer Collection		2.0± 0.1
1-11938 P		Heizer Collection		2.1± 0.1
1-11923 Q		Heizer Collection		2.4± 0.1
1-11924 R		Heizer Collection		3.1± 0.1
Site: (b) (3) Cultural Resources (ARPA)				
1495- (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) S-1	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	Surface	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	NM= NM
Site: (b) (3) Cultural Resources (ARPA)				
1495- (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) S-1	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	Surface	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
Isolates				
1495- (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) ISO3	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	Surface	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- ISO4		Surface		NM± NM
1495- ISO5		Surface		NM± NM
Site: (b) (3) Cultural Resources (ARPA)				
1495- (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) 2-1-1 A	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	Test pit 2, 0-10 cm	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- 2-1-1 B		Test pit 2, 0-10 cm		NM± NM
1495- 2-2-1 A		Test pit 2, 10-20 cm		NM± NM
1495- 2-2-1 B		Test pit 2, 10-20 cm		4.8± 0.1

Table 4.1 (cont). Redmond Caves (b) (5) Cultural Resources submitted for obsidian analysis to date.

Specimen No.	Description	Comments	Source	Rim Results
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-3-1 A	Test pit 2, 20-30 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	3.1± 0.1
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-3-1 B	Test pit 2, 20-30 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	3.2± 0.1
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-3-1 C	Test pit 2, 20-30 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	5.4± 0.1
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-3-1 D	Test pit 2, 20-30 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	4.9± 0.1
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-3-1 E	Test pit 2, 20-30 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-3-1 F	Test pit 2, 20-30 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	5.1± 0.1
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-3-1 G	Test pit 2, 20-30 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	5.4± 0.1
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-3-1 H	Test pit 2, 20-30 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	5.1± 0.1
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-4-2 A	Test pit 2, 30-40 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	5.2± 0.1
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-4-2 B	Test pit 2, 30-40 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	5.0± 0.1
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-5-1	Test pit 2, 30-40 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	5.0± 0.1
Site: (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)				
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1-1-1 A	Test pit 1, 0-5 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1-1-1 B	Test pit 1, 0-5 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1-1-1 C	Test pit 1, 0-5 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1-2-1 A	Test pit 1, 5-10 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1-2-1 B	Test pit 1, 5-10 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1-3-1 A	Test pit 1, 0-15 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1-3-1 B	Test pit 1, 0-15 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1-4-1 A	Test pit 1, 15-20 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1-4-1 B	Test pit 1, 15-20 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-1-1 A	Test pit 2, 0-5 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-1-1 B	Test pit 2, 0-5 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-1-1 C	Test pit 2, 0-5 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-2-1 A	Test pit 2, 5-10 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-2-1 B	Test pit 2, 5-10 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	NM± NM
1495- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	2-3-1	Test pit 2, 10-15 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	5.3± 0.1
Site: (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)				
1571- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	P1-1-1A	Probe 1, 0-10 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	4.2± 0.0
1571- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	P1-1-1B	Probe 1, 0-10 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	4.4± 0.1
1571- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	P1-1-1C	Probe 1, 0-10 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	3.0± 0.1
1571- (b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	P1-1-1D	Probe 1, 0-10 cm	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1.9± 0.1

Table 4.1 (cont.). Redmond Caves (b) (5) Cultural Resource submitted for obsidian analysis to date.

Specimen No.	Description	Comments	Source	Rim Results
1571 (b) (5) Cultural Resource	P1-2-1A (b) (5) Cultural Resource (ARPA & Sec. 304, NHPA)	Probe 1, 10-20 cm	(b) (5) Cultural Resource	2.8± 0.1
1571 (b) (5) Cultural Resource	P1-2-1B	Probe 1, 10-20 cm	(b) (5) Cultural Resource	3.0± 0.1
1571 (b) (5) Cultural Resource	P1-2-1C	Probe 1, 10-20 cm	(b) (5) Cultural Resource	3.5± 0.1
1571 (b) (5) Cultural Resource	P1-4-1	Probe 1, 30-40 cm	(b) (5) Cultural Resource	3.0± 0.1
1571 (b) (5) Cultural Resource	P2-1-1	Probe 2, 0-10 cm	(b) (5) Cultural Resource	3.3± 0.0
1571 (b) (5) Cultural Resource	P3-4-1	Probe 3, 30-40 cm	(b) (5) Cultural Resource	3.3± 0.1
1571 (b) (5) Cultural Resource	P5-1-1	Probe 5, 0-10 cm	(b) (5) Cultural Resource	3.9± 0.1
1571 (b) (5) Cultural Resource	P6-1-1	Probe 6, 0-10 cm	(b) (5) Cultural Resource	3.9± 0.1
1571 (b) (5) Cultural Resource	P7-1-1A	Probe 7, 0-10 cm	(b) (5) Cultural Resource	3.2± 0.1
1571 (b) (5) Cultural Resource	P7-1-1B	Probe 7, 0-10 cm	(b) (5) Cultural Resource	3.3± 0.1
1571 (b) (5) Cultural Resource	P7-1-1C	Probe 7, 0-10 cm	(b) (5) Cultural Resource	3.8± 0.1
1571 (b) (5) Cultural Resource	P8-5-1	Probe 8, 40-50 cm	(b) (5) Cultural Resource	3.3± 0.1
1571 (b) (5) Cultural Resource	P10-2-1	Probe 10, 10-20 cm	(b) (5) Cultural Resource	NA± NA
1571 (b) (5) Cultural Resource	P11-4-1	Probe 11, 30-40 cm	(b) (5) Cultural Resource	3.3± 0.1
1571 (b) (5) Cultural Resource	P12-1-1	Probe 12, 0-10 cm	(b) (5) Cultural Resource	3.3± 0.1
1571 (b) (5) Cultural Resource	P12-2-1	Probe 12, 10-20 cm	(b) (5) Cultural Resource	4.1± 0.1
1571 (b) (5) Cultural Resource	P12-3-1	Probe 12, 20-30 cm	(b) (5) Cultural Resource	3.0± 0.1
1571 (b) (5) Cultural Resource	P13-1-1	Probe 13, 0-10 cm	(b) (5) Cultural Resource	4.4± 0.1
Site: Cave				
1571 (b) (5) Cultural Resource	1-4-1	TP1 30-40 cm	(b) (5) Cultural Resource (ARPA & Sec. 304, NHPA)	3.7± 0.1
1571 (b) (5) Cultural Resource	1-1-1-A	TP1 0-10 cm	(b) (5) Cultural Resource	3.7± 0.1
1571 (b) (5) Cultural Resource	1-2-1-A	TP1 10-20 cm	(b) (5) Cultural Resource	3.6± 0.1
1571 (b) (5) Cultural Resource	1-2-1-B	TP1 10-20 cm	(b) (5) Cultural Resource	3.5± 0.1
1571 (b) (5) Cultural Resource	1-2-1-C	TP1 10-20 cm	(b) (5) Cultural Resource	3.5± 0.1
1571 (b) (5) Cultural Resource	1-2-1-D	TP1 10-20 cm	(b) (5) Cultural Resource	3.5± 0.1
1571 (b) (5) Cultural Resource	1-2-1-E	TP1 10-20 cm	(b) (5) Cultural Resource	3.4± 0.1
1571 (b) (5) Cultural Resource	1-2-1-F	TP1 10-20 cm	(b) (5) Cultural Resource	3.6± 0.1
1571 (b) (5) Cultural Resource	1-2-1-G	TP1 10-20 cm	(b) (5) Cultural Resource	3.5± 0.1
1571 (b) (5) Cultural Resource	1-2-1-H	TP1 10-20 cm	(b) (5) Cultural Resource	3.7± 0.1
1571 (b) (5) Cultural Resource	1-3-1-A	TP1 20-30 cm	(b) (5) Cultural Resource	2.8± 0.1
1571 (b) (5) Cultural Resource	1-3-1-B	TP1 20-30 cm	(b) (5) Cultural Resource	3.0± 0.1
1571 (b) (5) Cultural Resource	1-3-1-C	TP1 20-30 cm	(b) (5) Cultural Resource	3.0± 0.1
1571 (b) (5) Cultural Resource	1-3-1-D	TP1 20-30 cm	(b) (5) Cultural Resource	2.9± 0.1
1571 (b) (5) Cultural Resource	1-3-1-E	TP1 20-30 cm	(b) (5) Cultural Resource	3.3± 0.1

Table 4.1 (cont.). Redmond Caves (b) (5) Cultural Resources submitted for obsidian analysis to date.

Specimen No.	Description	Comments	Source	Rim Results
1571	(b) (5) Cultural Resources (b) (5) Cultural Resources (NHPA & Sec. 304, NHPA)	TP1 20-30 cm	(b) (5) Cultural Resources	3.3± 0.1
1571	(b) (5) Cultural Resources	TP1 30-40 cm	(b) (5) Cultural Resources	3.5± 0.1
1571	(b) (5) Cultural Resources	TP1 30-40 cm	(b) (5) Cultural Resources	3.2± 0.1
1571	(b) (5) Cultural Resources	TP1 30-40 cm	(b) (5) Cultural Resources	3.7± 0.1
1571	(b) (5) Cultural Resources	TP1 30-40 cm	(b) (5) Cultural Resources	3.0± 0.1
1571	(b) (5) Cultural Resources	TP1 30-40 cm	(b) (5) Cultural Resources	3.6± 0.1
1571	(b) (5) Cultural Resources	TP1 30-40 cm	(b) (5) Cultural Resources	3.6± 0.1
1571	(b) (5) Cultural Resources	TP1 30-40 cm	(b) (5) Cultural Resources	2.6± 0.1
1571	(b) (5) Cultural Resources	TP1 30-40 cm	(b) (5) Cultural Resources	3.2± 0.1
1571	(b) (5) Cultural Resources	TP1 30-40 cm	(b) (5) Cultural Resources	NA
1571	(b) (5) Cultural Resources	TP1 40-50 cm	(b) (5) Cultural Resources	3.0± 0.1
1571	(b) (5) Cultural Resources	TP1 40-50 cm	(b) (5) Cultural Resources	3.0± 0.1
1571	(b) (5) Cultural Resources	TP1 40-50 cm	(b) (5) Cultural Resources	2.9± 0.0
1571	(b) (5) Cultural Resources	TP1 40-50 cm	(b) (5) Cultural Resources	3.3± 0.1
1571	(b) (5) Cultural Resources	TP1 40-50 cm	(b) (5) Cultural Resources	3.5± 0.1
1571	(b) (5) Cultural Resources	TP1 40-50 cm	(b) (5) Cultural Resources	2.7± 0.1
1571	(b) (5) Cultural Resources	TP1 40-50 cm	(b) (5) Cultural Resources	3.0± 0.1
1571	(b) (5) Cultural Resources	TP1 50-60 cm	(b) (5) Cultural Resources	3.2± 0.1
1571	(b) (5) Cultural Resources	TP1 50-60 cm	(b) (5) Cultural Resources	3.2± 0.1
1571	(b) (5) Cultural Resources	TP1 50-60 cm	(b) (5) Cultural Resources	2.8± 0.1
1571	(b) (5) Cultural Resources	TP1 50-60 cm	(b) (5) Cultural Resources	3.7± 0.1
1571	(b) (5) Cultural Resources	TP1 50-60 cm	(b) (5) Cultural Resources	2.8± 0.1
1571	(b) (5) Cultural Resources	TP1 50-60 cm	(b) (5) Cultural Resources	3.0± 0.1
1571	(b) (5) Cultural Resources	TP1 60-70 cm	(b) (5) Cultural Resources	3.1± 0.1
1571	(b) (5) Cultural Resources	TP1 60-70 cm	(b) (5) Cultural Resources	2.7± 0.1
1571	(b) (5) Cultural Resources	TP1 60-70 cm	(b) (5) Cultural Resources	3.0± 0.1
1571	(b) (5) Cultural Resources	TP1 60-70 cm	(b) (5) Cultural Resources	3.2± 0.1
1571	(b) (5) Cultural Resources	TP1 60-70 cm	(b) (5) Cultural Resources	2.6± 0.1
1571	(b) (5) Cultural Resources	TP1 60-70 cm	(b) (5) Cultural Resources	2.8± 0.1
1571	(b) (5) Cultural Resources	TP1 70-80 cm	(b) (5) Cultural Resources	2.3± 0.1
1571	(b) (5) Cultural Resources	TP1 70-80 cm	(b) (5) Cultural Resources	NA
1571	(b) (5) Cultural Resources	TP1 70-80 cm	(b) (5) Cultural Resources	3.0± 0.1
1571	(b) (5) Cultural Resources	TP1 70-80 cm	(b) (5) Cultural Resources	NA
1571	(b) (5) Cultural Resources	TP1 70-80 cm	(b) (5) Cultural Resources	3.0± 0.1

Table 4.1 (cont.). Redmond Caves [REDACTED] submitted for obsidian analysis to date.

Specimen No.	Description	Comments	Source	Rim Results
1571[REDACTED] 1-8-1-G	[REDACTED]	TP1 70-80 cm	[REDACTED]	2.4± 0.1
1571[REDACTED] 1-8-1-F	[REDACTED]	TP1 70-80 cm	[REDACTED]	NA
1571[REDACTED] 1-8-1-H	[REDACTED]	TP1 70-80 cm	[REDACTED]	3.0± 0.1
1571[REDACTED] 1-9-2-A	[REDACTED]	TP1 80-90 cm	[REDACTED]	NA
1571[REDACTED] 1-9-2-B	[REDACTED]	TP1 80-90 cm	[REDACTED]	3.0± 0.1
1571[REDACTED] 1-9-2-C	[REDACTED]	TP1 80-90 cm	[REDACTED]	2.6± 0.1
1571[REDACTED] 1-9-2-D	[REDACTED]	TP1 80-90 cm	[REDACTED]	2.1± 0.1
1571[REDACTED] 1-9-2-E	[REDACTED]	TP1 80-90 cm	[REDACTED]	2.7± 0.1
1571[REDACTED] 1-9-2-F	[REDACTED]	TP1 80-90 cm	[REDACTED]	2.3± 0.1
1571[REDACTED] 1-9-2-G	[REDACTED]	TP1 80-90 cm	[REDACTED]	3.2± 0.1
1571[REDACTED] 1-10-1-A	[REDACTED]	TP1 90-100 cm	[REDACTED]	2.6± 0.1
1571[REDACTED] 1-11-1-A	[REDACTED]	TP1 100-110 cm	[REDACTED]	2.9± 0.1
1571[REDACTED] 1-11-1-B	[REDACTED]	TP1 100-110 cm	[REDACTED]	2.7± 0.1
1571[REDACTED] 1-11-1-C	[REDACTED]	TP1 100-110 cm	[REDACTED]	3.0± 0.1

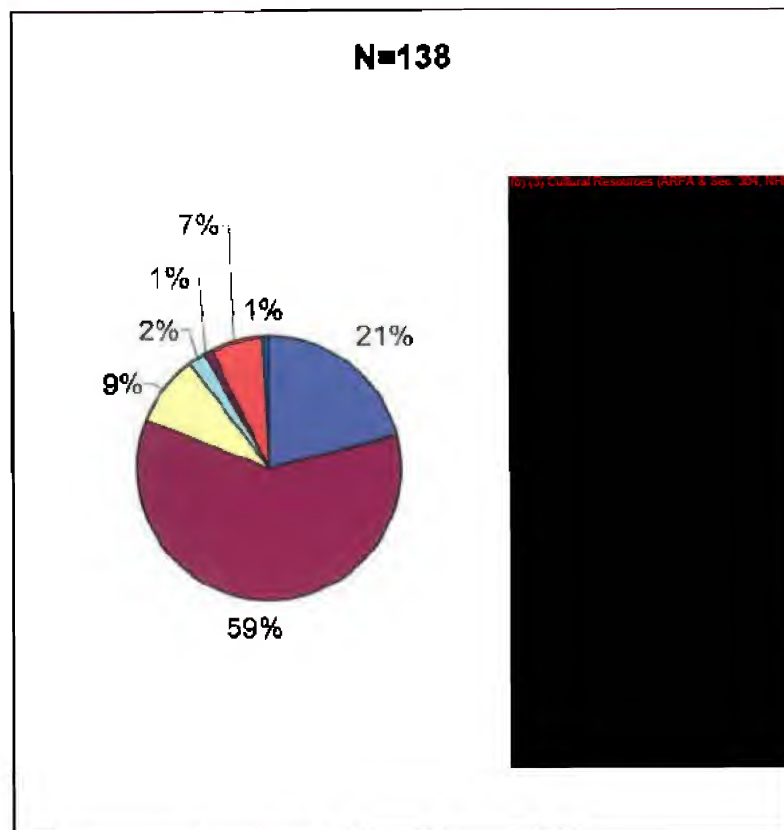


Figure 4.1. Graph showing the percentages of obsidian sources represented by [REDACTED] Redmond Caves specimens.

Table 4.2. List of geochemical sources identified by site at Redmond Caves parcel.

Geologic Source	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	Total
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)		
Total	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	

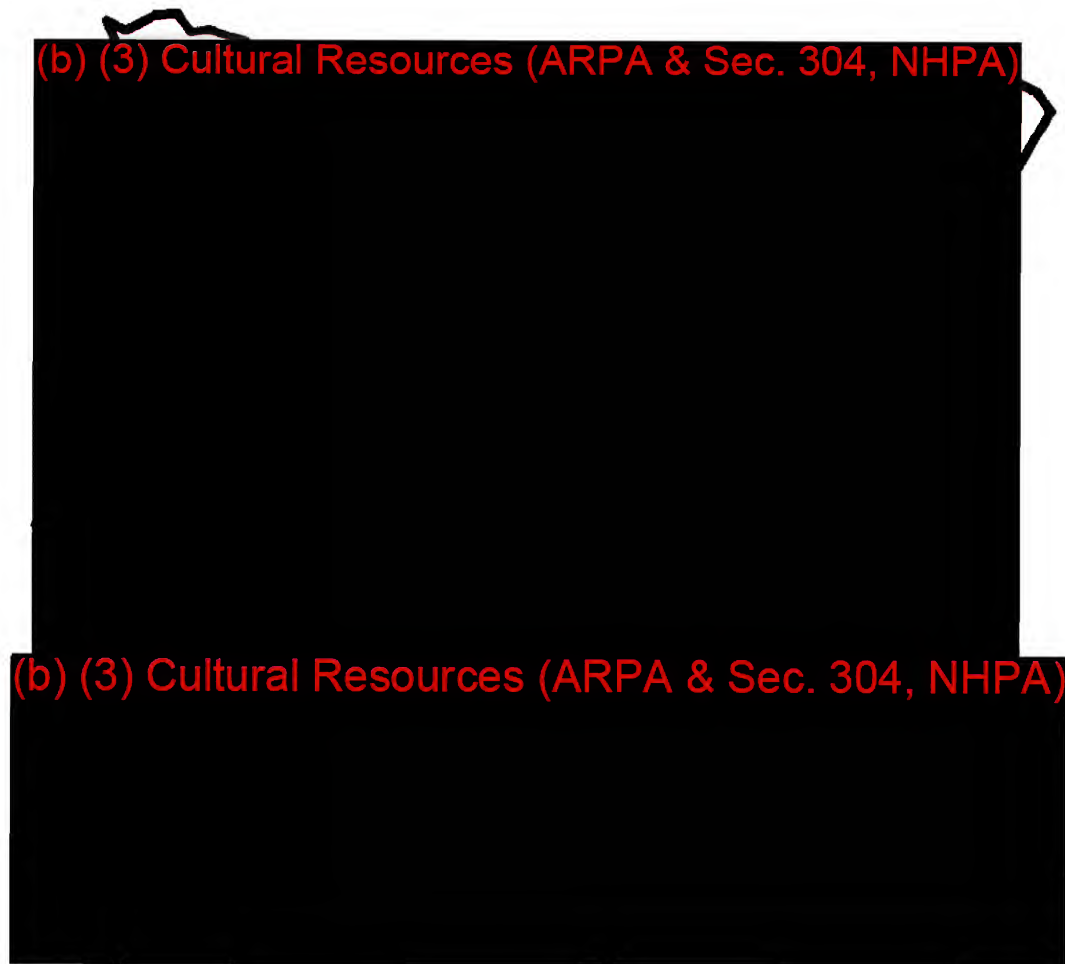


Figure 4.2. Location of geochemical sources represented by obsidian specimens from Cave Test Pit 1 at Redmond Caves (Appendix).

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



A larger sample of geochemically analyzed obsidian (b) (3) Cultural Resources from the Redmond Caves parcel is necessary in order to interpret the significance of the source diversity represented by (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) both within and across sites on the parcel.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) Further analysis must also be conducted on the variation of results between cave and non-cave sites. Only (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) from within the caves have been analyzed thus far. Geochemical characterization of (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) recovered from within the caves is necessary to better address the relationship of cave vs. non-cave sites in the area.

Obsidian Hydration

Obsidian hydration is a dating technique known to archaeologists for at least four decades (Friedman and Smith 1960). It is based on the principle that atmospheric water diffuses into the surface and interior of the natural volcanic glass. This action produces a visible rim that can be viewed and measured with the aid of a microscope. Specimens are prepared on a thin-section slide and the thickness of the “hydration rind” is measured and recorded. These measurements produce evidence of relative dates, with thicker hydration rinds suggesting older dates. However, the hydration rates are known to vary with obsidian source material (Skinner 2002), therefore it is essential to perform X-ray fluorescence analysis to determine the source of the material in order to interpret the significance of the hydration reading for any given specimen.

Hydration rates are influenced by variables such as chemical composition, temperature, water vapor pressure, and soil alkalinity (Skinner 2002). Calibration of hydration rates must then be developed with consideration of physiographic region, climate, and geologic source material.

(b) (3) Cultural Resources (ARPA & Sec 304, NHPA) obsidian samples from Cave TP1 (35DS173) were sent to Northwest Research Obsidian Studies Laboratory in Corvallis, Oregon in the spring of 2004 (Appendix) for obsidian hydration analysis. (b) (3) Cultural Resources (ARPA & Sec 304, NHPA) of these samples produced readable hydration rinds. Hydration rim readings range from 2.1-3.7 (Appendix). The significance of these results will be evident as research continues on the Redmond Caves Archeological Project. As the number of samples increase for this project and as radiocarbon dates associated with subsurface deposits become available, statistical analyses of the hydration results should contribute to our emerging understanding of the dates of prehistoric occupation in the area. These results may also be compared and combined with similar hydration studies from other sites in Central Oregon and lead to the development and refinement of regional hydration rates. Such studies have the potential to contribute significantly to our understanding of the archaeology of Central Oregon as a whole.

Debitage Analysis

(b) (3) Cultural Resources (ARPA & Sec 304, NHPA)

Flake class consists of four different debitage categories: complete flake, broken flake, flake fragment, and debris. A complete flake is a flake in which the striking platform (point of applied force) is present and the margins are intact (not broken). A broken flake contains the platform, but the margins are broken. A flake fragment is a flake in which the platform is missing. Debitage that exhibits no discernable single interior surface is classified as debris. Sullivan and Rosen (1985) argue that high proportions of broken flakes and flake fragments in an assemblage suggest that flaked tool manufacture occurred at the site, while high proportions of complete fragments and debris suggest core reduction.

The amount of cortex on each piece of debitage is used to determine whether a flake is categorized as a primary, secondary, or interior flake. A primary flake contains 90 – 100% of cortical material on the dorsal surface. The dorsal surface of a secondary flake contains a lesser percentage of cortex; while no cortex is present on an interior flake. Size categorizations were

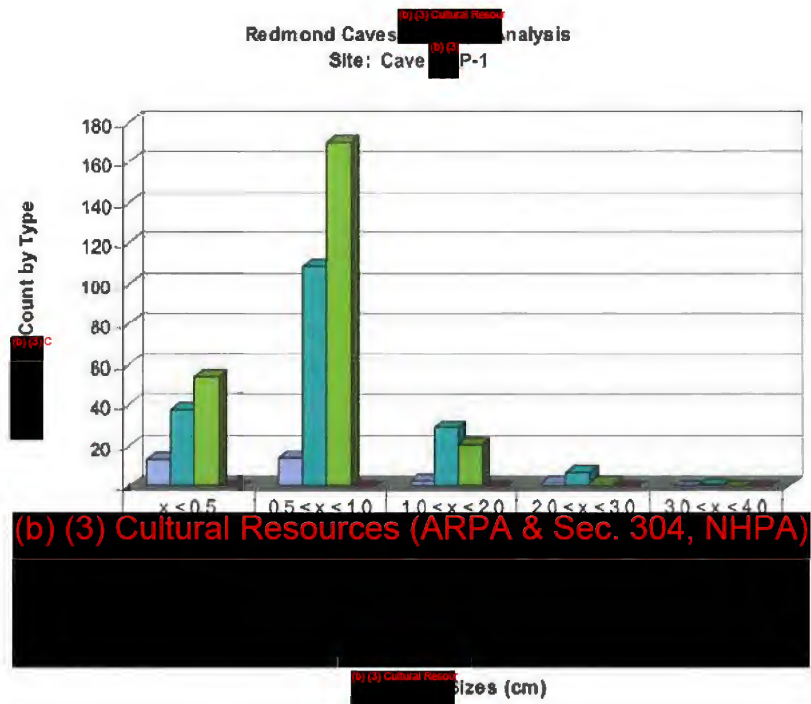
determined by placing the flakes in a series of concentric rings measuring 0.5 cm, 1 cm, 2 cm, 3 cm, 4 cm and 5 cm.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) These data are consistent with
debitage analysis conducted previously at other sites outside the caves (Helzer 2003;2004).

Future studies at the Redmond Caves parcel will involve the excavation of probes and
test pits from within the caves. Analysis on **(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)**

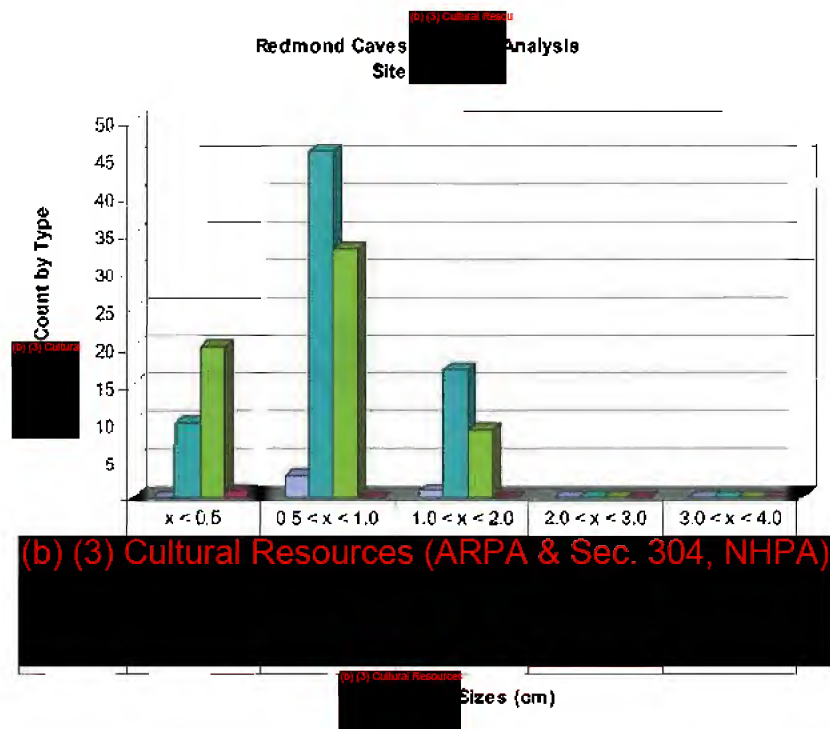
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



Count by Type/Size (cm)	
Size (cm)	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
$x < 0.5$	
$0.5 < x < 1.0$	
$1.0 < x < 2.0$	
$2.0 < x < 3.0$	
$3.0 < x < 4.0$	
Total	

Percentage by Type/Size (cm)	
Size (cm)	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
$x < 0.5$	
$0.5 < x < 1.0$	
$1.0 < x < 2.0$	
$2.0 < x < 3.0$	
$3.0 < x < 4.0$	
Total	

Figure 4.3 Results from (b) (3) Cultural Resources analysis of (b) (3) Cultural Resources from Cave TP1 (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



Count by Type/Size (cm)	
Size (cm)	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
$x < 0.5$	
$0.5 < x < 1.0$	
$1.0 < x < 2.0$	
$2.0 < x < 3.0$	
$3.0 < x < 4.0$	
Total	

Percentage by Type/Size (cm)	
Size (cm)	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
$x < 0.5$	
$0.5 < x < 1.0$	
$1.0 < x < 2.0$	
$2.0 < x < 3.0$	
$3.0 < x < 4.0$	
Total	

Figure 4.4. Results of analysis of from

CHAPTER 5: CONCLUSION

This report represents the completion of the fourth term of a multi-year project in which University of Oregon students, under the guidance of the staff at the Oregon State Museum of Anthropology, engage in archaeological research at Redmond Caves. The work is being conducted for the City of Redmond and the Bureau of Land Management, who are engaged in a collaborative effort to develop the [REDACTED] BLM parcel into a city managed park. Students involved in this project are enrolled in the Archaeology Field Studies class (ANTH 408) in Bend. The course is offered in the fall and spring terms; each term is divided into fieldwork and laboratory analysis (Figures 5.1 and 5.2).



Figure 5.1. UO students working on TP1 at Cave [REDACTED] view to the north.

The first year of archaeological investigations at the Redmond Caves parcel (fall term 2002 and spring term 2003) included a pedestrian survey (in which sites and isolated finds were identified and mapped), subsurface testing in the proposed parking lot area, subsurface testing in site [REDACTED] and analysis of [REDACTED] recovered from the caves by Robert Heizer in 1941. A total of seven sites (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) and seven isolates outside the caves were identified and mapped during this first year of investigations. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Subsurface investigations were conducted at sites [REDACTED]

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Investigations during the fall term of 2003 included the excavation of probes in sites (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA). Generally, sediment deposits were shallow at these sites and no cultural features were identified. No further archaeological investigations are recommended at these locations. Fieldwork also included the mapping of the interior of two caves, Cave (b) (3) and Cave (b) (3). These maps will aid in planning the sampling strategy for excavations within the caves.

The spring of 2004 involved the discovery and testing of an eighth site outside the caves (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA). The site is located along the dirt roadway leading from the south entrance of the parcel to Cave (b) (3). Twenty-eight probes were excavated in this site. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA). The site is similar to the other sites which have been investigated outside the caves. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA). No further archaeological investigations are recommended at this location.



Figure 5.2. University of Oregon students conducting laboratory work associated with the Redmond Caves Archaeological Project.

Obsidian studies were also conducted on (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) from the Redmond Caves sites. X-ray fluorescence was performed on obsidian (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) by Northwest Research Obsidian Laboratory in Corvallis, Oregon. Seven geochemical sources of (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) were detected at the Redmond Caves sites. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA). (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA). Obsidian hydration on (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) has produced hydration rinds that range from 2.3 – 3.7 microns. As more specimens are collected and analyzed, comparative

studies with other sites in central Oregon and the development of hydration rates for the region will be possible. Thus, obsidian studies associated with this project have the potential to substantially enhance our understanding of human trade, migration, and settlement patterns of the past.

Plans for the third year of fieldwork for Redmond Caves Archaeological Project include continued mapping of the cave interiors and beginning the investigations of archaeological resources within the caves. These activities will take place with close consultation with the Bureau of Land Management and the City of Redmond.

References Cited

- Connolly, Thomas J.
1999 *Newberry Crater: A Ten-Thousand-Year Record of Human Occupation in The Basin-Plateau Borderlands*. University of Utah Anthropological Papers. The University of Utah Press, Salt Lake City, UT.
- Fagan, John L.
1998 Redmond Caves Master Plan Cultural Resources. Letter report for David Evans & Associates, Bend, Oregon and the City of Redmond. Archaeological Investigations Northwest, Inc. Report No. 223.
- Franklin, Jerry F., and C.T. Dyrness.
1988 *Natural Vegetation of Oregon and Washington*, Oregon State University Press, Corvallis, OR.
- Friedman, Irving and Robert L. Smith
1960 A New Dating Method Using Obsidian: Part I, The Development of the Method. *American Antiquity* 25: 476-522.
- Heizer, Robert F.
1941 Redmond Caves artifacts. Accession # 100 GB. Catalogued as specimens 1-11918 to 1-11941. State Museum of Natural History. University of Oregon, Eugene, OR.
- Helzer, Margaret M., editor
2003 *Redmond Caves Archaeological Project. An Interim Report: Fall 2002*. Oregon State Museum of Nature History. University of Oregon . Submitted to Bureau of Land Management Prineville District and the City of Redmond.
- Helzer, Margaret M., editor
2004 *Redmond Caves Archaeological Project. An Interim Report: Fall 2003*. Oregon State Museum of Nature History. University of Oregon . Submitted to Bureau of Land Management Prineville District and the City of Redmond.
- Hughes, Richard E. and Craig Skinner
1994 *Variability in Obsidian Source Use in Central Oregon*. Paper presented at the 59th Annual meeting of the Society of American Archaeology, Anaheim, California.
- Lebow, Clayton G, Richard M. Pettigrew, Jon M. Silvermoon, David H. Chance, Robert Boyd, Yvonne Hajda, and Henry Zenk
1990 *A Cultural Resource Overview for the 1990's*. Bureau of Land Management, Prineville District, Oregon. Cultural Resource Series No. 5. Bureau of Land Management, Portland, Oregon.
- Skinner, Craig E.
1995a Obsidian Characterization Studies. In *Archaeological Investigations, PGT-PG &E Pipeline Expansion Project, Idaho, Washington, Oregon and California, Vol. 5: Technical Studies*, by R.U. Bryson, C.E. Skinner, and R.M. Pettigrew, chapter 4. Prepared by Infotec Research and for Western Anthropological Research Group for Pacific Gas Transmission Company.

- Skinner, Craig E.
1995b Obsidian Hydration Studies. In *Archaeological Investigations, PGT-PG &E. Pipeline Expansion Project, Idaho, Washington, Oregon and California, Vol. 5: Technical Studies*, by R.U. Bryson, C.E. Skinner, and R.M. Pettigrew, chapter 5. Prepared by Infotec Research and for Western Anthropological Research Group for Pacific Gas Transmission Company.
- Skinner, Craig E.
2002 *Introduction to Obsidian Characterization and Introduction to Hydration Studies*. Northwest Research Obsidian Studies Laboratory.
 http://www.obsidianlab.com/info_xrf.html
- Skinner, Craig E. and Jennifer J. Thatcher
2003 *X-Ray Fluorescence Analysis and Obsidian Hydration Measurement of Artifact Obsidian from Sites 35-DS-173, 35-DS-1076, 35-DS-1599, RC-1, RC-4, and Three Isolates, Redmond Caves Vicinity, Deschutes County, Oregon*. Northwest Research Obsidian Studies Laboratory. Report prepared for the State Museum of Anthropology, University of Oregon
- Sullivan, Alan P. and Kenneth C. Rosen
1985 Debitage Analysis and Archaeological Interpretation. *American Antiquity*, 50:755-779.

APPENDIX

X-RAY Fluorescence Analysis and Obsidian Hydration Measurement of Artifact Obsidian from Sites (b) (5) Cultural Resources (ARPA & Sec Redmond Caves, Deschutes County, Oregon

X-Ray Fluorescence Analysis and Obsidian Hydration Measurement of Artifact Obsidian from [REDACTED] Redmond Caves, Deschutes County, Oregon

Craig E. Skinner and Jennifer J. Thatcher
Northwest Research Obsidian Studies Laboratory

[REDACTED] obsidian [REDACTED] from [REDACTED] Redmond Caves, Deschutes County, Oregon, were submitted for energy dispersive X-ray fluorescence trace element provenance analysis. The specimens were also processed for hydration rim measurements. The samples were prepared and analyzed at the Northwest Research Obsidian Studies Laboratory under the accession number 2004-54.

Analytical Methods

X-Ray Fluorescence Analysis. Nondestructive trace element analysis of the samples was completed using a Spectrace 5000 energy dispersive X-ray fluorescence spectrometer. The system is equipped with a Si(Li) detector with a resolution of 155 eV FWHM for 5.9 keV X-rays (at 1000 counts per second) in an area 30 mm². Signals from the spectrometer are amplified and filtered by a time variant pulse processor and sent to a 100 MHz Wilkinson type analog-to-digital converter. The X-ray tube employed is a Bremsstrahlung type, with a rhodium target, and 5 mil Be window. The tube is driven by a 50 kV 1 mA high voltage power supply, providing a voltage range of 4 to 50 kV. For the elements Zn, Ga, Rb, Sr, Y, Zr, Nb, Th, and Pb that are reported in Table A-1, we analyzed the collection with a collimator installed and used a 45 kV tube voltage setting and 0.60 mA tube current setting.

The diagnostic trace element values used to characterize the samples are compared directly to those for known obsidian sources reported in the literature and with unpublished trace element data collected through analysis of geologic source samples (Northwest Research 2004a). [REDACTED] are correlated to a parent obsidian source (or geochemical source group) if diagnostic trace element values fall within about two standard deviations of the analytical uncertainty of the known upper and lower limits of chemical variability recorded for the source. Occasionally, visual attributes are used to corroborate the source assignments although sources are never assigned solely on the basis of megascopic characteristics.

Obsidian Hydration Analysis. An appropriate section of each [REDACTED] is selected for hydration slide preparation. Two parallel cuts are made into the edge of the [REDACTED] using a lapidary saw equipped with 4-inch diameter diamond-impregnated .004" thick blades. The resultant cross-section of the [REDACTED] (approximately one millimeter thick) is removed and mounted on a petrographic microscope slide with Lakeside thermoplastic cement and is then ground to a final thickness of 30-50 microns.

The prepared slide is measured using an Olympus BHT petrographic microscope fitted with a filar screw micrometer eyepiece. When a clearly defined hydration layer is identified, the section is centered in the field of view to minimize parallax effects. Four rim measurements are typically recorded for each [REDACTED] or examined surface. Hydration rinds smaller than one micron often cannot be resolved by optical microscopy. Hydration thicknesses are reported to the nearest 0.1 μ m and represent the mean value for all readings. Standard deviation values for each measured surface indicate the variability for hydration thickness measurements recorded for each specimen. It is important to note that these values reflect only the reading uncertainty of the rim values and do not take into account the resolution limitations of the microscope or other sources of uncertainty that enter into the formation of hydration rims.

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Additional details about specific analytical methods and procedures used for the analysis of the elements reported in Table A-1 and the preparation and measurement of hydration rims are available at the Northwest Research Obsidian Studies Laboratory World Wide Web site at www.obsidianlab.com (Northwest Research 2004a).

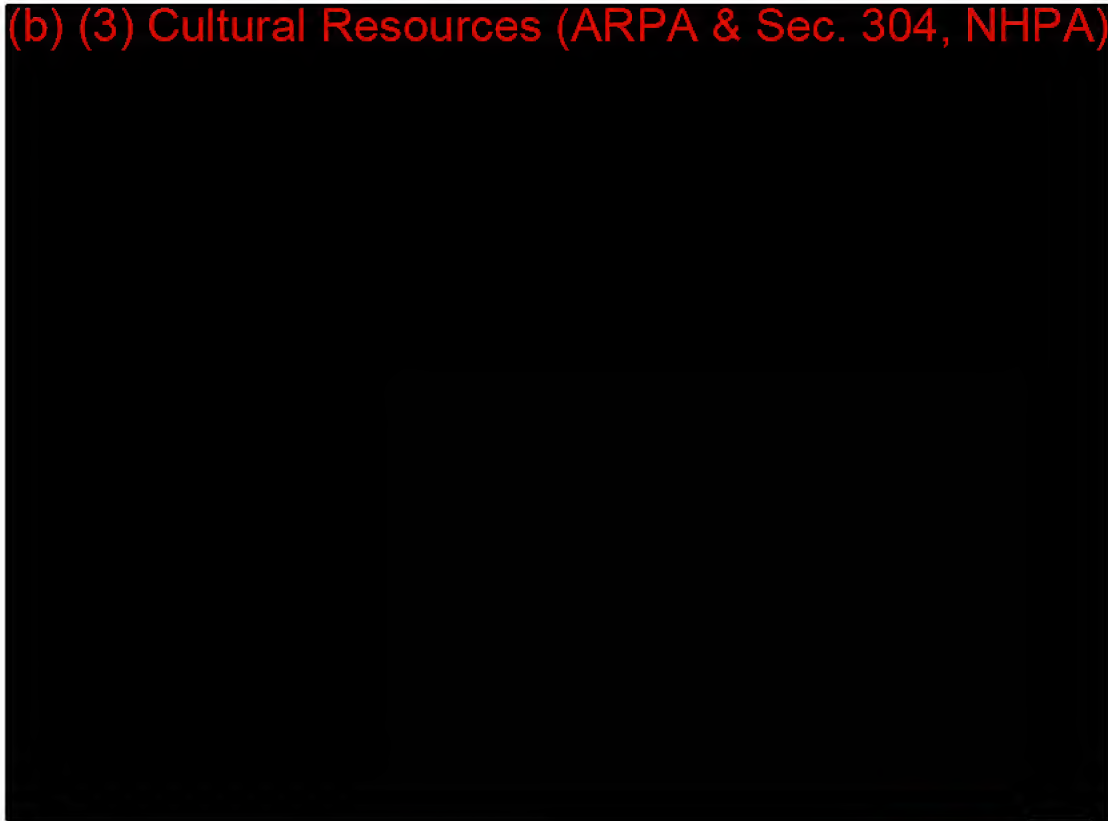
Results of Analysis

X-Ray Fluorescence Analysis. Five geochemical obsidian sources, four of which were correlated with known geologic sources, were identified among the [REDACTED] obsidian [REDACTED] that were characterized by X-ray fluorescence analysis. The locations of the site and the identified obsidian sources are shown in Figure 1. Analytical results are presented in Table A-1 in the Appendix and are summarized in Table 1 and Figure 2. Additional descriptive information about the obsidian sources may be found at www.sourcecatalog.com (Northwest Research 2004b).

Table 1. Summary of results of trace element studies of artifacts.

Geologic Source	N=	Percentage
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)		
Total		

Figure 1. Locations of the site and the identified obsidian sources.



(b) (3) Cultural Resource

(b) (3) Cultural Resource

(b) (3) Cultural Resources

(b) (3) Cultural Resources - [REDACTED]

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

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Obsidian Hydration Analysis. All of the [REDACTED] that were characterized by X-ray fluorescence analysis were prepared for obsidian hydration analysis and yielded [REDACTED] measurable rims. The specimen slides are curated at the Northwest Research Obsidian Studies Laboratory under accession number 2004-54. The results are reported in Table B-1 in the Appendix and are summarized in Table 2.

Table 2. Summary of results of obsidian hydration analysis of (b) (3) Cultural Reso

[illegible]

References Cited

- Northwest Research Obsidian Studies Laboratory
2004a Northwest Research Obsidian Studies Laboratory World Wide Web Site (www.obsidianlab.com).
- 2004b Northwest Research U. S. Obsidian Source Catalog (www.sourcecatalog.com).
- 1995 Obsidian Characterization Studies. In *Archaeological Investigations, PGT-PC&E Pipeline Expansion Project, Idaho, Washington, Oregon, and California, Volume V: Technical Studies*, by Robert U. Bryson, Craig E. Skinner, and Richard M. Pettigrew, pp. 4.1 4.54. Report prepared for Pacific Gas Transmission Company, Portland, Oregon, by INFOTEC Research Inc., Fresno, California, and Far Western Anthropological Research Group, Davis, California.
- Skinner, Craig E. And Jennifer J. Thatcher
2003 *X-Ray Fluorescence Analysis and Obsidian Hydration Measurement of Artifact Obsidian from 35 DS 173, 35-DS-1076, 35-DS-1599, and Three Isolates, Redmond Caves Vicinity, Deschutes County, Oregon*. Report 2003-06 prepared for the State Museum of Anthropology, Eugene, Oregon, by Northwest Research Obsidian Studies Laboratory, Corvallis, Oregon.

Appendix

Results of X-Ray Fluorescence and Obsidian Hydration Analysis

Northwest Research Obsidian Studies Laboratory

Table A-1. Results of XRF Studies: Redmond Caves, Deschutes County, Oregon

Site	Specimen No.	Catalog No.	Trace Element Concentrations											Ratios		Geochemical Source
			Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	Fe ₂ O ₃ ^T	Fe:Mn	Fe:Ti	
(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)	1	1571-1-1-1	NM	NM	112	69	39	240	13	NM	NM	886	NM	48.1	32.4	(b) (5) Cultural Resources (ARPA & Sec. 304, NHPA)
			± NM	NM	4	9	3	7	1	NM	NM	33	NM			
	2	1571-1-1-1-A	NM	NM	151	69	48	295	16	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	3	1571-1-2-1-A	NM	NM	135	61	42	275	17	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	4	1571-1-2-1-B	NM	NM	134	56	41	275	17	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	5	1571-1-2-1-C	NM	NM	148	66	42	296	17	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	6	1571-1-2-1-D	NM	NM	136	57	41	272	16	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	7	1571-1-2-1-E	NM	NM	149	67	47	294	15	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	8	1571-1-2-1-F	NM	NM	160	74	41	274	18	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	9	1571-1-2-1-G	NM	NM	145	87	43	260	14	NM	NM	NM	NM	47.0	46.8	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	10	1571-1-2-1-H	NM	NM	161	73	46	303	18	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	11	1571-1-3-1-A	NM	NM	150	66	45	293	16	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	12	1571-1-3-1-B	NM	NM	170	72	48	303	16	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	13	1571-1-3-1-C	NM	NM	166	77	46	309	18	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	14	1571-1-3-1-D	NM	NM	160	74	44	298	17	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	15	1571-1-3-1-E	NM	NM	163	80	41	289	17	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	16	1571-1-3-1-F	NM	NM	190	74	49	313	24	NM	NM	NM	NM	NM	NM	
			± NM	NM	5	9	3	7	2	NM	NM	NM	NM			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
 NA = Not available; ND = Not detected; NM = Not measured.; * = Small sample.

Northwest Research Obsidian Studies Laboratory

Table A-1. Results of XRF Studies: (b) (5) Cultural Resources (ARPA) Redmond Caves, Deschutes County, Oregon

Site	Specimen		Trace Element Concentrations											Ratios		Geochemical Source	
	No.	Catalog No.	Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	Fe2O3 ^T	Fe:Mn	Fe:Ti		
(b) (3) Cultural Resources (ARPA)	17	1571	1-4-2-A	NM	NM	132	83	43	265	11	NM	NM	800	NM	54.8	46.5	(b) (3) Cultural Resources (ARPA & Sec. 204, NEPA)
				± NM	NM	4	9	3	7	2	NM	NM	34	NM			
	18	1571	1-4-2-B	NM	NM	155	68	49	293	19	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	19	1571	1-4-2-C	NM	NM	172	88	29	217	8	NM	NM	NM	NM	51.3	37.7	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	20	1571	1-4-2-D	NM	NM	171	78	47	306	21	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	21	1571	1-4-2-E	NM	NM	161	71	45	302	16	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	22	1571	1-4-2-F	NM	NM	155	73	44	298	16	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	23	1571	1-4-2-G	NM	NM	144	91	41	270	11	NM	NM	NM	NM	56.6	43.4	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	24	1571	1-4-2-H	NM	NM	164	65	45	288	17	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	25	1571	1-4-2-I	NM	NM	148	66	41	296	18	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	26	1571	1-5-1-A	NM	NM	139	64	40	285	16	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	27	1571	1-5-1-B	NM	NM	133	64	42	275	17	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	28	1571	1-5-1-C	NM	NM	142	87	46	270	15	NM	NM	808	NM	50.3	46.7	
				± NM	NM	4	9	3	7	2	NM	NM	34	NM			
	29	1571	1-5-1-D	NM	NM	142	65	41	285	16	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	30	1571	1-5-1-E	NM	NM	143	67	44	285	16	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	31	1571	1-5-1-F	NM	NM	100	123	15	104	6	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	32	1571	1-5-1-G	NM	NM	174	72	46	307	21	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
 NA = Not available; ND = Not detected; NM = Not measured.; * = Small sample.

Northwest Research Obsidian Studies Laboratory

Table A-1. Results of XRF Studies: (b) (3) Cultural Resources (NPS) Redmond Caves, Deschutes County, Oregon

Site	Specimen		Trace Element Concentrations												Ratios		Geochemical Source
	No.	Catalog No.	Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	Fe2O3 ^T	Fe:Mn	Fe:Ti		
(b) (3) Cultural Resources	33	1571	1-6-1-A	NM	NM	81	107	17	100	7	NM	NM	NM	NM	NM	NM	(b) (3) Cultural Resources (NPSA & Sec. 304, NPSA)
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	34	1571	1-6-1-B	NM	NM	94	124	17	104	6	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	35	1571	1-6-1-C	NM	NM	86	119	18	102	9	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	36	1571	1-6-1-D	NM	NM	161	73	46	293	19	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	37	1571	1-6-1-E	NM	NM	157	70	46	199	10	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	38	1571	1-6-1-F	NM	NM	154	69	44	287	20	NM	NM	NM	NM	NM	NM	
				± NM	NM	5	9	3	7	2	NM	NM	NM	NM			
	39	1571	1-7-1-A	NM	NM	98	121	17	107	13	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	40	1571	1-7-1-B	NM	NM	146	73	41	295	15	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	41	1571	1-7-1-C	NM	NM	145	63	40	288	17	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	42	1571	1-7-1-D	NM	NM	95	126	16	103	12	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	43	1571	1-7-1-E	NM	NM	163	81	45	308	21	NM	NM	872	NM	31.8	47.3	
				± NM	NM	4	9	3	7	2	NM	NM	33	NM			
	44	1571	1-7-1-F	NM	NM	93	110	18	104	10	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	45	1571	1-8-1-A	NM	NM	178	78	52	205	11	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	46	1571	1-8-1-B	NM	NM	140	66	44	280	17	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	47	1571	1-8-1-C	NM	NM	145	62	43	284	15	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	48	1571	1-8-1-D	NM	NM	133	57	41	278	19	NM	NM	NM	NM	NM	NM	
				± NM	NM	4	9	3	7	1	NM	NM	NM	NM			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
 NA = Not available; ND = Not detected; NM = Not measured.; * = Small sample.

Northwest Research Obsidian Studies Laboratory

Table A-1. Results of XRF Studies: (b) (5) Cultural Resources (ARPA) Redmond Caves, Deschutes County, Oregon

Site	Specimen		Trace Element Concentrations											Ratios		Geochemical Source
	No.	Catalog No.	Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	Fe ₂ O ₃ ^T	Fe:Mn	Fe:Ti	
(b) (5) Cultural Resources (ARPA)	49	1571- (b) (5) -1-8-1-E	NM	NM	91	112	16	97	8	NM	NM	NM	NM	NM	NM	(b) (5) Cultural Resources (ARPA & Geo. Sur., ARPA)
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	50	1571- (b) (5) -1-8-1-F	NM	NM	165	68	47	302	17	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	51	1571- (b) (5) -1-8-1-G	NM	NM	166	69	48	301	15	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	52	1571- (b) (5) -1-8-1-H	NM	NM	170	73	51	301	19	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	53	1571- (b) (5) -1-9-2-A	NM	NM	147	63	44	291	21	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	54	1571- (b) (5) -1-9-2-B	NM	NM	143	66	42	277	19	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	55	1571- (b) (5) -1-9-2-C	NM	NM	162	69	44	279	19	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	56	1571- (b) (5) -1-9-2-D	NM	NM	161	70	38	302	18	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	57	1571- (b) (5) -1-9-2-E	NM	NM	182	77	46	286	14	NM	NM	NM	NM	NM	NM	
			± NM	NM	5	9	3	8	2	NM	NM	NM	NM			
	58	1571- (b) (5) -1-9-2-F	NM	NM	182	80	42	310	18	NM	NM	NM	NM	NM	NM	
			± NM	NM	5	9	3	8	2	NM	NM	NM	NM			
	59	1571- (b) (5) -1-9-2-G	NM	NM	182	80	44	307	14	NM	NM	NM	NM	NM	NM	
			± NM	NM	5	9	3	8	2	NM	NM	NM	NM			
	60	1571- (b) (5) -1-10-1-A	NM	NM	133	58	39	274	17	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	1	NM	NM	NM	NM			
	61	1571- (b) (5) -1-11-1-A	NM	NM	184	83	42	311	18	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	62	1571- (b) (5) -1-11-1-B	NM	NM	159	76	44	302	21	NM	NM	NM	NM	NM	NM	
			± NM	NM	4	9	3	7	2	NM	NM	NM	NM			
	63	1571- (b) (5) -1-11-1-C	NM	NM	176	81	49	306	20	NM	NM	NM	NM	NM	NM	
			± NM	NM	5	9	3	8	2	NM	NM	NM	NM			
NA	RGM-1	RGM-1	NM	NM	155	102	24	218	9	NM	NM	792	NM	60.6	36.5	RGM-1 Reference Standard
			± NM	NM	4	9	3	7	1	NM	NM	32	NM			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.

NA = Not available; ND = Not detected; NM = Not measured; * = Small sample.

Northwest Research Obsidian Studies Laboratory

Table B-1. Obsidian Hydration Results and Sample Provenience: Redmond Caves, Deschutes County, Oregon

Site	Specimen		Unit	Depth (cm)	Type ^a	Source	Hydration Rims		Comments ^b
	No.	Catalog No.					Rim 1	Rim 2	
(b) (5) Cultural Resources (ARPA)	1	1571-1-1-4-1	TP1	Level 4	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.7± 0.1	NM ± NM	—
	2	1571-1-1-1-A	TP1	Level 1	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.7± 0.1	NM ± NM	—
	3	1571-1-2-1-A	TP1	Level 2	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.6± 0.1	NM ± NM	—
	4	1571-1-2-1-B	TP1	Level 2	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.5± 0.1	NM ± NM	Ventral is PAT, UNR
	5	1571-1-2-1-C	TP1	Level 2	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.5± 0.1	NM ± NM	Dorsal and BRE are PAT, UNR
	6	1571-1-2-1-D	TP1	Level 2	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.5± 0.1	NM ± NM	Dorsal is PAT, UNR
	7	1571-1-2-1-E	TP1	Level 2	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.4± 0.1	NM ± NM	Dorsal is PAT, UNR
	8	1571-1-2-1-F	TP1	Level 2	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.6± 0.1	NM ± NM	DFV, PAT
	9	1571-1-2-1-G	TP1	Level 2	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.5± 0.1	NM ± NM	Dorsal is PAT, UNR
	10	1571-1-2-1-H	TP1	Level 2	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.7± 0.1	NM ± NM	Dorsal is PAT, UNR
	11	1571-1-3-1-A	TP1	Level 3	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	2.8± 0.1	NM ± NM	Dorsal is PAT, UNR
	12	1571-1-3-1-B	TP1	Level 3	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.0± 0.1	NM ± NM	Dorsal is PAT, UNR
	13	1571-1-3-1-C	TP1	Level 3	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.0± 0.1	NM ± NM	Dorsal is PAT, UNR
	14	1571-1-3-1-D	TP1	Level 3	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	2.9± 0.1	NM ± NM	REC; dorsal is PAT, UNR
	15	1571-1-3-1-E	TP1	Level 3	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.3± 0.1	NM ± NM	Ventral is PAT, UNR
	16	1571-1-3-1-F	TP1	Level 3	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.3± 0.1	NM ± NM	REC; dorsal is PAT, UNR
	17	1571-1-4-2-A	TP1	Level 4	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.5± 0.1	NM ± NM	Dorsal is PAT, UNR
	18	1571-1-4-2-B	TP1	Level 4	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.2± 0.1	NM ± NM	DFV
	19	1571-1-4-2-C	TP1	Level 4	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.7± 0.1	NM ± NM	Ventral is PAT, UNR
	20	1571-1-4-2-D	TP1	Level 4	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.0± 0.1	NM ± NM	Dorsal is PAT, UNR
	21	1571-1-4-2-E	TP1	Level 4	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.6± 0.1	NM ± NM	Dorsal is PAT, UNR
	22	1571-1-4-2-F	TP1	Level 4	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.6± 0.1	NM ± NM	Dorsal is PAT, UNR
	23	1571-1-4-2-G	TP1	Level 4	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	2.6± 0.1	NM ± NM	Dorsal is PAT, UNR
	24	1571-1-4-2-H	TP1	Level 4	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	3.2± 0.1	NM ± NM	Dorsal is PAT, UNR
	25	1571-1-4-2-I	TP1	Level 4	(b) (5) Cultural Resources (ARPA)	(b) (5) Cultural Resources (ARPA)	NA ± NA	NM ± NM	Dorsal is PAT, UNR

(b) (5) Cultural Resources (ARPA & Sec. 304, NHFA)

^a See text for explanation of comment abbreviations

NA = Not Available; NM = Not Measured; * = Small sample

Northwest Research Obsidian Studies Laboratory

Table B-1. Obsidian Hydration Results and Sample Provenience (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) Redmond Caves, Deschutes County, Oregon

Site	Specimen		Unit	Depth (cm)	Type ^A	Source	Hydration Rims		Comments ^B
	No.	Catalog No.					Rim 1	Rim 2	
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	26	1571-1-5-1-A	TP1	Level 5	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	3.0± 0.1	NM ± NM	UNR (crystalline)
	27	1571-1-5-1-B	TP1	Level 5			3.0± 0.1	NM ± NM	Dorsal is PAT, UNR
	28	1571-1-5-1-C	TP1	Level 5			2.9± 0.0	NM ± NM	--
	29	1571-1-5-1-D	TP1	Level 5			3.3± 0.1	NM ± NM	Dorsal is PAT, UNR
	30	1571-1-5-1-E	TP1	Level 5			3.5± 0.1	NM ± NM	Dorsal is PAT, UNR
	31	1571-1-5-1-F	TP1	Level 5			2.7± 0.1	NM ± NM	Dorsal is PAT, UNR
	32	1571-1-5-1-G	TP1	Level 5			3.0± 0.1	NM ± NM	Dorsal is PAT, UNR
	33	1571-1-6-1-A	TP1	Level 6			3.2± 0.1	NM ± NM	--
	34	1571-1-6-1-B	TP1	Level 6			3.2± 0.1	NM ± NM	--
	35	1571-1-6-1-C	TP1	Level 6			2.8± 0.1	NM ± NM	--
	36	1571-1-6-1-D	TP1	Level 6			3.7± 0.1	NM ± NM	--
	37	1571-1-6-1-E	TP1	Level 6			2.8± 0.1	NM ± NM	DFV
	38	1571-1-6-1-F	TP1	Level 6			3.0± 0.1	NM ± NM	Ventral is PAT, UNR
	39	1571-1-7-1-A	TP1	Level 7			3.1± 0.1	NM ± NM	Dorsal is PAT, UNR
	40	1571-1-7-1-B	TP1	Level 7			2.7± 0.1	NM ± NM	--
	41	1571-1-7-1-C	TP1	Level 7			3.0± 0.1	NM ± NM	Ventral is PAT, UNR
	42	1571-1-7-1-D	TP1	Level 7			3.2± 0.1	NM ± NM	--
	43	1571-1-7-1-E	TP1	Level 7			2.6± 0.1	NM ± NM	--
	44	1571-1-7-1-F	TP1	Level 7			2.8± 0.1	NM ± NM	--
	45	1571-1-8-1-A	TP1	Level 8			2.3± 0.1	NM ± NM	--
	46	1571-1-8-1-B	TP1	Level 8			NA ± NA	NM ± NM	REC
	47	1571-1-8-1-C	TP1	Level 8			3.0± 0.1	NM ± NM	PAT, OPA
	48	1571-1-8-1-D	TP1	Level 8			NA ± NA	NM ± NM	--
	49	1571-1-8-1-E	TP1	Level 8			3.0± 0.1	NM ± NM	REC; NVH
	50	1571-1-8-1-F	TP1	Level 8			NA ± NA	NM ± NM	--

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

^A See text for explanation of comment abbreviations

NA = Not Available; NM = Not Measured; * = Small sample

Northwest Research Obsidian Studies Laboratory

Table B-1. Obsidian Hydration Results and Sample Provenience (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) Redmond Caves, Deschutes County, Oregon

Site	Specimen		Unit	Depth (cm)	Type ^a	Source	Hydration Rims		Comments ^H
	No.	Catalog No.					Rim 1	Rim 2	
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	51	1571	1-8-1-G	TP1	Level 8	(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)	2.4 ± 0.1	NM ± NM	UNR (crystalline)
	52	1571	1-8-1-H	TP1	Level 8		3.0 ± 0.1	NM ± NM	--
	53	1571	1-9-2-A	TP1	Level 9		NA ± NA	NM ± NM	--
	54	1571	1-9-2-B	TP1	Level 9		2.4 ± 0.1	NM ± NM	UNR (crystalline)
	55	1571	1-9-2-C	TP1	Level 9		2.6 ± 0.1	NM ± NM	--
	56	1571	1-9-2-D	TP1	Level 9		2.1 ± 0.1	NM ± NM	Dorsal is PAT, UNR
	57	1571	1-9-2-E	TP1	Level 9		2.7 ± 0.1	NM ± NM	DFV
	58	1571	1-9-2-F	TP1	Level 9		2.3 ± 0.1	NM ± NM	--
	59	1571	1-9-2-G	TP1	Level 9		3.2 ± 0.1	NM ± NM	Dorsal is PAT, UNR
	60	1571	1-10-1-A	TP1	Level 10		2.6 ± 0.1	NM ± NM	--
	61	1571	1-11-1-A	TP1	Level 11		2.9 ± 0.1	NM ± NM	--
	62	1571	1-11-1-B	TP1	Level 11		2.7 ± 0.0	NM ± NM	--
	63	1571	1-11-1-C	TP1	Level 11		3.0 ± 0.1	NM ± NM	--

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

^a See text for explanation of comment abbreviations

NA = Not Available; NM = Not Measured; * = Small sample

Abbreviations and Definitions Used in the Comments Column

All hydration rim measurements are recorded in microns.

BEV - (Beveled). Artifact morphology or cut configuration resulted in a beveled thin section edge.

BRE - (Broken Edge). The thin section cut was made across a broken edge of the artifact. Resulting hydration measurements may reveal when the artifact was broken, relative to its time of manufacture.

DES - (DESTROYED). The artifact or flake was destroyed in the process of thin section preparation. This sometimes occurs during the preparation of extremely small items, such as pressure flakes.

DFV - (Diffusion Front Vague). The diffusion front, or the visual boundary between hydrated and unhydrated portions of the specimen, are poorly defined. This can result in less precise measurements than can be obtained from sharply demarcated diffusion fronts. The technician must often estimate the hydration boundary because a vague diffusion front often appears as a relatively thick, dark line or a gradation in color or brightness between hydrated and unhydrated layers.

DIS - (DIScontinuous). A discontinuous or interrupted hydration rind was observed on the thin section.

HV - (Highly Variable). The hydration rind exhibits variable thickness along continuous surfaces. This variability can occur with very well-defined bands as well as those with irregular or vague diffusion fronts.

IRR - (IRRegular). The surfaces of the thin section (the outer surfaces of the artifact) are uneven and measurement is difficult.

ISO - (1 Surface Only). Hydration was observed on only one surface or side of the thin section.

NOT - (NOT obsidian). Petrographic characteristics of the artifact or obsidian specimen indicate that the specimen is not obsidian.

NVI - (No Visible Hydration). No hydration rind was observed on one or more surfaces of the specimen. This does not mean that hydration is absent, only that hydration was not observed. Hydration rinds smaller than one micron often are not birefringent and thus cannot be seen by optical microscopy. "NVI" may be reported for the manufacture surface of a tool while a hydration measurement is reported for another surface, e.g. a remnant ventral flake surface.

OPA - (OPAque). The specimen is too opaque for measurement and cannot be further reduced in thickness.

PAT - (PATinated). This description is usually noted when there is a problem in measuring the thickness of the hydration rind, and refers to the unmagnified surface characteristics of the artifact, possibly indicating the source of the measurement problem. Only extreme patination is normally noted.

REC - (RECut). More than one thin section was prepared from an archaeological specimen. Multiple thin sections are made if preparation quality on the initial specimen is suspect or obviously poor. Additional thin sections may also be prepared if it is perceived that more information concerning an artifact's manufacture or use can be obtained.

UNR - (UNRcadable). The optical quality of the hydration rind is so poor that accurate measurement is not possible. Poor thin section preparation is not a cause.

WEA - (WEAthered). The artifact surface appears to be damaged by wind erosion or other mechanical action.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

State Oregon
710 N. E. Holladay
Portland 12, Oregon

MINERAL REPORT

Recreation and Public
Purposes Lease Application

of

City of Redmond, Oregon

(Title)

LANDS INVOLVED

Deschutes County, Oregon

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

January 24, 1963

(Date)

By
Robert F. Ciesiel
Valuation Engineer (Mining)

Approved

John R. Welch
Chief, Branch of Minerals MCL.

Date

1/24/63 31748

State Office
710 N. E. Holladay
Portland 12, Oregon

M-12386 (Oregon 011883)

Land Involved

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Record Data

The land is public domain in Federal ownership. The caves were examined on January 9, 1963, by Bud Lee, Land Examiner of the Prineville BLM District Office, and the undersigned. The surrounding land was examined by the undersigned on January 10, 1963.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

The terrain is mostly flat with very slight changes in elevation. The soil is predominantly blow sand. Vegetation consists of sagebrush, rabbitbrush and juniper.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Geology

The area is covered by lava flows, as is the immediate area under consideration. However, there are lava tunnels within the area of application. The opening of these caves for public recreation is the purpose for the Recreation and Public Purpose Lease Application. These lava tunnels are not unique. Other and more extensive caves or lava tunnels are found near Bend. There are reports of other lava caves throughout the area.

Pertinent Information

The enclosed map was made of the caves, and it was realized that the caves are virtually just one lava tunnel. The roof of the lava tunnel has collapsed in several places, making separate caves. These surface depressions or roof collapses are quite apparent when seen. They are characterized by an abrupt drop in the surface ground along the flanks of the tunnel and a gradual dip to abrupt drop at the ends of the tunnel. These depressions are partly filled with blow sand.

One opening, which is now in the center of a lumber mill yard, was filled in as it hampered operation of the mill. (b) (6) Personal Privacy and another resident of Redmond said that in their youth they crawled through this part of the lava tunnel in a southeast direction, coming out at the northwesternmost cave, No. [REDACTED], as shown on the map. They also went from the past opening in the lumber mill yard in a northwestern direction to about where the railroad track went over the lava tunnel, a distance of about 600 feet.

Another depression caused by the collapse of the roof of the lava tunnel was found about 500 feet to the southeast of the (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) cave opening, No. [REDACTED] as shown on the map.

The extent of this lava tunnel was traced for a distance of about 2,200 feet.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

The dimensions of the caves range from maximums of 60 feet in width and 20 feet in height down to caves numbered [REDACTED] on the map, which are about 10 feet wide and filled with sand to within 2 feet of their roofs. These two caves, if excavated of blow sand, would probably be about as large as the other caves. The larger caves have a floor of blow sand and pumiceous dust at least 6 to 8 feet in depth, which makes the caves dusty when disturbed. In places, there are blocks of lava lying on the floor which have fallen from the roof. Some areas are extremely hazardous because of the loose rocks in the roof of the caves. The entrance to cave No. [REDACTED] was blasted by dynamite for no apparent reason by persons unknown, almost closing it to access.

Although the weather at the time of inspection was near zero, the temperature inside the caves was quite pleasant, except for the tunnel with two entrances. The year around temperature of the caves probably ranges around 50° - 60°F.

There were no indications of or valuable minerals found in the caves or adjacent area. There are no buildings on the land.

Cave No. [REDACTED] was found by the City of Redmond in 1954 by drilling from the surface, the cave being located by the drill steel's dropping abruptly after piercing the roof. The cave was opened by removing blow sand from its entrance.

Inquiries of local people were made concerning the finding of (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) in these caves. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) There are considerable recent "diggings" in cave No. [REDACTED]. The other large caves also show evidence of some digging.

Evidently, the majority of these (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) were uncovered and taken by

(b) (6) Personal Privacy

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

This collection had been on loan to the University of Oregon during 1956 and 1957.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Mr. John Berning, Redmond City Superintendent, said that when the city uncovered (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) which was "latched onto" by a University of Oregon coed who was at the scene. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) The city thought it best not to further disturb this cave, and made an attempt to block the entrance, with the anticipation of some archaeological group scientifically excavating the site. The city requested individuals not to disturb the site and have been unsuccessful in interesting a scientific group in the project.

The cave has since been opened enough for easy access, but there didn't appear to be much digging.

Conclusions

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

of [REDACTED] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) for which the City of Redmond has asked under their
Recreation and Public Purposes application, the uncovered caves are only

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Robert F. Ciesiel

Robert F. Ciesiel
Valuation Engineer (Mining)

Enclosures:

Map

Photos (2 sheets)

Orig.: L.O. (Oregon 011883) ✓

cc: M-12386

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

DM, Prineville
Ciesiel

REDMOND CAVES

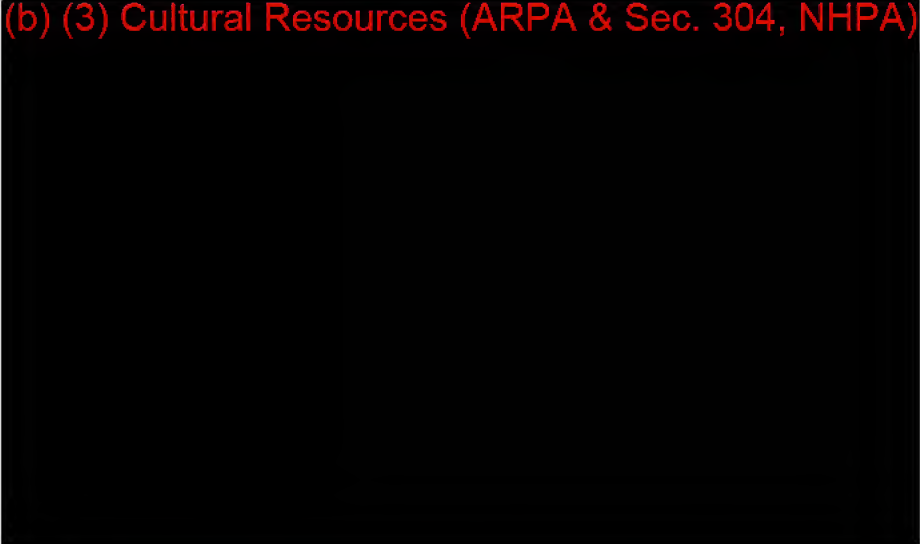
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



①

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



②

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



③

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



④

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



⑤

Redmond Caves Master Plan

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

January 11, 1999



Prepared by



DAVID EVANS AND
ASSOCIATES, INC.

for the



in cooperation
with the



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Appendix A: Interim Cave Management Policy for BLM Caves in Oregon

Appendix B: Bibliography



The Master Plan was created with the guidance and review of the **Redmond Caves Grant Team**:

City of Redmond

Mary Meloy Director Public Works

Helen Moor Public Involvement, Public Works

Don Cooper Park Division, Public Works

Bureau of Land Management

Sara Nichols Wildlife Biologist

Ron Gregory, Deschutes Area Archaeologist

U.S. Forest Service

Karen Bushnell Jones Public Affairs Specialist

Site Description and Background

Background

The Redmond caves site encompasses a [REDACTED] area of natural lava tube caves and native juniper woodland (Figure 1). The property is currently owned by the Bureau of Land Management (BLM) but is [REDACTED] Redmond's city limits. The site is [REDACTED]

[REDACTED] Eventually, the caves site will be surrounded by light industrial uses. The new Deschutes County Fairgrounds are currently being built less than a mile to the south.

The Redmond caves have been listed as *significant* under the Federal Cave Resources Protection Act (FCRPA) due to their cultural, recreational, biological, and educational resource values. The caves site is currently managed under the FCRPA and the Interim Cave Management Policy for BLM Caves in Oregon (Appendix A).

The Bureau of Land Management (BLM) and the City of Redmond have entered into a joint agreement to manage the Redmond caves site as a public park with an emphasis on education. This agreement commits the City to prepare a Master Plan that describes how best to rehabilitate, preserve, and maintain the resources of the Redmond caves site. The City plans to submit a lease application to BLM under the Recreation and Public Purposes Act (see discussion below).

The Redmond caves site is an unique asset for the City of Redmond and Central Oregon because it is very accessible and located near an urban area. The caves site provides a very attractive opportunity for interpretation, education, and recreation. However, rehabilitation efforts are needed to repair and keep up with the high levels of damage from ongoing misuse of the site.

Section 1



The Redmond Caves have been listed as *significant* under the Federal Cave Resources Protection Act due to their cultural, recreational, biological, and educational resource values.

Figure 1. Site Location Map

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



Because of unregulated access and the resultant vandalism, the caves are currently relatively unsafe and unattractive for the general public, especially children. Graffiti, broken glass, and smoke stains from illegal campfires are present in all of the caves. At the present time, the local Boy Scouts and the City of Redmond are continuing a clean-up program of the caves site. }

The goal of this Master Plan is to establish basic guidelines for development and management of the site. The emphasis is on providing opportunities for the public to learn appropriate caving behavior and the resource values associated with Oregon's lava tube caves. In particular, the participants in this planning effort hope that the Redmond caves site could be used to teach the public good safety and preservation behaviors that would help protect more remote and less disturbed caves. The challenge is to develop a Master Plan that would rehabilitate, protect, and manage the caves site for both recreation and education. Most importantly, the Master Plan must be feasible to implement. ←

+ BLM

The emphasis is on providing opportunities for the public to learn appropriate caving behavior and the resource values associated with Oregon's lava tube caves.

Objectives

As established by BLM and the City of Redmond, the objectives of the Master Plan are the following:

1. Identify management strategies to rehabilitate and enhance the caves and their surrounding environment consistent with the Federal Cave Resources Protection Act for the protection of significant cave resources (the caves were listed as significant in 1995);
2. Limit the degradation of the caves, soils, and vegetation that results from uncontrolled human access;
3. Maintain the caves, trails, and other facilities in accordance with State and Federal requirements to provide a safe and attractive visitor experience; and
4. Implement an interpretive and educational program that protects and highlights the unique, archaeological, biological, and geological attributes of the caves.

Recreation and Public Purposes Act

This Master Plan will be used in the application process defined in the Recreation and Public Purposes Act (R&PP), under which the City of Redmond would apply to lease the caves site from the BLM. Land included in R&PP applications for leases must be shown to be part of a definite, well-planned project with specific purposes to benefit the public. A development and management plan is required. As identified in the R&PP guide, the master plan must include the following elements:

1. *A statement of the proposed use of the lands, a detailed description of the proposed project, and a statement describing administration of the tract (Sections 1, 4, 5, 6 and 7).*
2. *The anticipated expenditure for development (including source of funds to be used for development) (Section 9).*
3. *A map showing the nature and location of facilities, land ownership of the entire project, and access routes (Section 5).*
4. *Timetable for development (Section 8).*
5. *Explanation of proposed maintenance responsibilities and procedures (Section 6).*

In addition, this plan includes a summary of existing information (Section 2), identifies information gaps (Section 3), and describes the existing and potential use of the site (Section 4).

Public Involvement

A Redmond Caves Grant Team consisting of BLM, US Forest Service (USFS), the City of Redmond, and the consultant was established to guide and monitor the Caves Master Plan. The Caves Team met five times over the course of the project.

Two public meetings were held. The first was in June, 1998. This meeting was held on-site and included a guided cave visit as well as background information. Over 100 people attended this first meeting. The second public meeting was held in November, 1998 to present the draft Master Plan.

An on-site meeting with Klamath, Burns-Paiute, and Confederated Tribes of Warm Springs was held on June 8, 1998. Approximately 20 people attended. The meeting was an opportunity to begin to share the Tribes' oral history about the caves site and to get their impressions on the best ways to manage the area. It was at this meeting that a possible name for the future park was mentioned. According to Bridget Whipple, staff to the Warm Springs Culture and Heritage Committee, *Tuulí Pušpuš Pa* is the Sahaptin name used by elders to describe the Redmond caves site. The name appears to be particularly appropriate to the caves site. Permission to use this name should be requested from the Confederated Tribes of Warm Springs Reservation of Oregon.



Tuulí Pušpuš Pa is the Sahaptin name used by elders to describe the Redmond Caves site.

Review of Existing Information

As part of the background research for the Caves Master Plan, queries were made of local and regional libraries, historical societies, experts, interest groups, and agencies. The Redmond caves have long been of interest to a wide variety of people, including native people, settlers, residents, cavers, see (2) Cultural Resources (NRPA & B) and naturalists. However, there is not a great deal of information reflected in available historical and academic literature. For example, although general information related to lava tube formation is very accessible, specific references to the formation of the Redmond caves complex are rare.

Sources consulted during background research included the following:

- ❖ Central Oregon Community College Library;
- ❖ Internet;
- ❖ University of Oregon Library;
- ❖ BLM files;
- ❖ Deschutes County Historical Society;
- ❖ Redmond Historical Commission;
- ❖ Oregon Headquarters of the National Speleological Society (NSS);
- ❖ The High Desert Grotto (Central Oregon Chapter of the NSS); and
- ❖ On-site meeting with regional Tribal representatives.

A bibliography of the information located is listed in Appendix B. This information would be useful in developing the text for the interpretive program (see Section 7, Interpretation and Education).



It should also be noted that valuable information regarding the caves site may be held by individuals and groups who have used, visited, and explored the caves site over the years. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

The following section includes a brief summary of information pertaining to the site, gathered from the resources identified during research for this project.

Cultural Resources

The Redmond caves have long been known as a source of (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) The caves provided temporary shelter, and possibly a summer water source (in the form of ice). The Redmond caves were officially recorded as an archaeological site in 1983. Local newspaper accounts, BLM minerals reports, and correspondence between the BLM and National Park Service

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

For this Master Plan, Dr. John Fagan of Archaeological Investigations Northwest, Inc. conducted an analysis of the caves site, including a literature search, records review, and a pedestrian reconnaissance-level survey. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Data gaps should be filled by formulating a research design that includes conducting a thorough cultural resources survey of the (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) parcel, implementing a site testing plan, and evaluating site significance against National Register of Historic Places criteria. Additional measures would include developing a plan to protect and preserve significant cultural resources. It would also be important to consult with local Tribal governments to determine if the caves site has value as a Traditional Cultural Property.

Wildlife and Habitat

The caves site and BLM public lands surrounding Redmond and Bend are characterized by old growth juniper woodlands. The old growth juniper woodlands are a unique habitat type, since

less than 3% of all juniper woodlands in Oregon are characterized by trees older than 100 years. In the spring and summer, old growth juniper woodlands support a high diversity of breeding bird species. In the winter, the woodlands typically support large flocks of songbirds.

With the increasing urban population, the environment has been altered in both the caves and the surrounding area. Levels of disturbance have increased as a result of unregulated recreation, nearby industrial uses, and vehicle traffic. Off-road vehicle use and road construction have resulted in pockets of weeds and non-native vegetation. Some native wildlife species have also been displaced by human presence and disturbance. Although a variety of wildlife species can still be observed on the site, over time the area will increasingly favor "urban" or "backyard" wildlife.

The site's small size (b) (5) Cultural Resource and its location (b) (5) Cultural Resource the city limits, surrounded by private light industrial use, also limits wildlife diversity.

Bats

The northwestern population of the big-eared bat (*Corynorhinus townsendii*) is a U.S. Fish and Wildlife Service *Species of Concern* and a BLM *Sensitive Species*. The big-eared bat is state listed in Oregon as *Sensitive-Critical*. BLM field inventories of the Redmond caves have recorded very small numbers of western big-eared bats. Field studies conducted from 1986 to 1995 have located from one to three bats using the caves for hibernation (winter roosting). Accounts from local residents suggest that the caves had "many" bats in the past. It is likely that these reports are true, and that the Redmond caves historically supported a much larger colony of western big-eared bats.

All bats are easily disturbed by human presence, and the western big-eared bat is known to be particularly sensitive to disturbance. The main threat to this species has been the disturbance of roosting sites from recreational caving or any other activity that involves human entry, noise, or vibration. Surveys conducted in Oregon indicate that many historic roost sites have been negatively impacted in recent years. Most monitored colonies have had moderate to sizable reduction in numbers.

The Redmond caves continue to have the potential to provide winter or summer roosting habitat for bat species other than the western big-eared bat. Current use is limited by human visitation, but the BLM has documented small numbers of big brown bats (*Eptesicus fuscus*) and small-footed myotis (*Myotis*



— this is vague!
 where did these accounts come from?
 did someone do interviews?

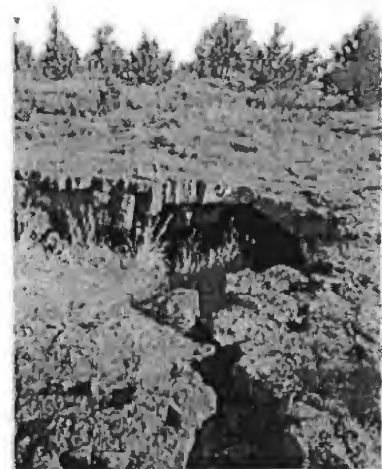
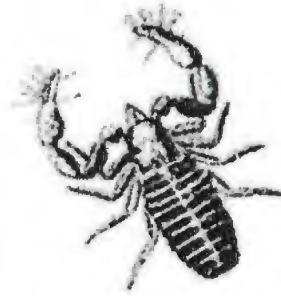
Three species of bats have
 used the caves for roosting.

ciliolabrum) using the site for night roosting during the summer (Perkins, 1998). Based on current biological information, use of the caves for daytime recreation and education would likely not affect the remaining bat populations, particularly if activities cease at dusk as recommended (see Section 5).

Redmond Caves False-Scorpion

An article in the *American Museum of Natural History Bulletin* (Number 123, 1962), describes a holotype (only known example of a species) of Charlotte's false-scorpion (*Parobisium charlotteae*) as having been collected in June 1938 from the "Redmond lava cave." It is likely that this is a reference to the Redmond caves; however, the 1962 description of the insect was from the 1938 collection housed at the American Museum of Natural History and the location derived from original field notes.

The Charlotte's false-scorpion is described as large and reddish brown in color. It is also described as blind or semi-blind, which may indicate that the species is found only in caves. Little else is known about the insect. If additional efforts have been undertaken to locate representatives of the Charlotte's false-scorpion, no records were made. If the false-scorpion is present in the Redmond caves, and is indeed a rare species, it may be considered Threatened or Endangered. At the least, the record of the species is an interesting addition to the natural history of the caves.



Geology

Like many of the geologic features of Central Oregon, the Redmond caves site complex was formed by volcanic flows from the Newberry Caldera, a shield volcano around 35 miles south of the caves site. The Redmond area is covered by a layer of volcanic flow called Newberry Basalt, typically 50 to 100 feet thick, that originated on the flanks of Newberry Caldera during the Pleistocene Epoch (around 10,000 to 2 million years ago). It is expected that the Newberry Basalt is relatively thick in the caves area, probably around 100 feet. Near the surface, the Newberry Basalt hosts many lava tubes, including the Redmond caves system. In most places, the basalt is covered with a thin layer of windblown sand and silt.

As the Newberry Caldera repeatedly erupted, the downslope flows created tubes that carried the hot fluid lava through areas that had cooled and hardened. Lava tubes became plugged as lava cooled, and new tubes formed. At times, the tubes emptied of lava. Some of the empty tubes subsequently collapsed and are

visible today as topographic depressions. Others are now lava tube caves.

The Redmond caves complex consists of five known caves. Most are relatively shallow, although two of the caves are joined by a narrow connection. The caves have deep, sandy floors, with scattered fallen ceiling blocks. The complex is virtually one lava tube, with individual "caves" separated by roof collapse. The dimensions of the caves range from 60 feet wide and 20 feet tall to 10 feet wide and 2 feet tall. Many passages have been filled with sand that has blown in. The smaller caves are suspected to be as large as the main passages, if the blow sand were to be excavated. The large caves have floors consisting of blow sand and pumice dust at least 6 to 8 feet deep. Because of this, the caves are very dusty when disturbed.

The caves have been reported to extend beyond the BLM property onto private property. A 1963 BLM Mineral Report mentions that local residents entered a cave on private property to the northeast of the subject property, crawled in a southwesterly direction, and exited at another cave opening. The report also mentions that the same residents crawled from the lumber yard entrance in a northwesterly direction for approximately 600 feet. The entrance was apparently in the middle of a lumber yard, and was filled. According to the mineral report, the entrance to Cave No. (b)(5) (Figure 2) was blasted closed by dynamite for "...no apparent reason..." This cave remains closed by fill.

5 caves

The Redmond Caves complex consists of five known caves... The possibility remains that undiscovered lava tubes are present on the site.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

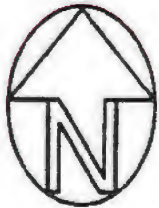
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Redmond Caves

Deschutes County, Oregon

Figure 2. Cave Locations

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



0 50 100



Scale Feet

Legend

Breakdown

Sand

Ceiling Height

Slope

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Cave survey by the members of the Oregon High Desert Grotto
of the National Speleological Society, Bend, Oregon.
For more info contact the N.S.S. at 2813 Cave Ave, Huntsville, AL 35810

Note: Caves are shown in approximate relationship as mapped by
Global Positioning System (GPS).

Additional Inventory Needs

The literature search and interviews conducted for this Master Plan revealed several deficiencies. A general description of appropriate methodology is included. A recommended schedule for completion of these additional inventories is included in Section 8.

Some of these topics may be excellent senior or masters degree projects for college students. The City may wish to contact the Central Oregon Community College and institutions such as the University of Oregon to establish the feasibility of using students to provide additional inventory information for the site, especially for more academic components, such as the search for the Charlotte's false-scorpion.

Cultural Resources

- ❖ Conduct a onetime systematic archaeological and cultural survey of the entire [redacted] parcel that includes recordation of all sites and isolates. Site boundaries would be fully delineated and documented during the course of the survey. All cultural clearances would be completed before ground-disturbing activities.
- ❖ Shovel test sites only when necessary to determine National Register of Historic Places eligibility.
- ❖ Evaluate sites for significance using National Register of Historic Places criteria.
- ❖ If necessary, develop a research design for data recovery. The design must meet State Historic Preservation Office (SHPO) and BLM approval.
- ❖ Determine the site's potential as a Traditional Cultural Property. Designation of Traditional Cultural Properties located on public lands must have SHPO concurrence.
- ❖ Record an oral history of the caves site from testimony provided by tribal elders and longtime residents of Redmond.

#5

Some of these topics may be excellent senior or masters degree projects for college students...

- Record an oral history.
- Monitor bat use.
- Search for Charlotte's false-scorpion.
- Search for additional lava tube caves.
- Count users.

Wildlife

- ❖ Continue to monitor bat use via existing BLM methodology. This consists of a diurnal (daytime) examination for winter roosting bats every one to two years, and summer surveys including visual and electronic detection.
- ❖ Conduct a search for the Charlotte's false-scorpion. Methodology for this search should be established by an entomologist.

Geology

- ❖ Conduct a site survey to locate any additional lava tube caves on-site. Methodology for this survey should be determined by the BLM. Methods used by Siemans and Associates (1996) for the 13th Street alignment is one technique to be considered.

Recreation

- ❖ It would be beneficial for planning and funding purposes to better understand how many people are currently using the caves site for recreation. This could be accomplished by a weekend and weekday count during the summer when use is likely to be the highest. Even if this is not feasible, counts should be made periodically as improvements are installed in the new park.

BLM
determined

Section 4

Existing and Potential Public Use

Existing Use

The Redmond caves site has long been used by local residents for cave exploration, off-highway driving, walking, shooting, and as an informal gathering spot. The caves site has also been the site of illegal activities such as (b) (2) Cultural Resources (NHPA & Geo. 3) and refuse dumping. Several generations of locals have visited the site for these and other reasons.

The caves site is currently in poor condition. The caves and soils do not appear to be supporting the current types of use (mainly off-highway vehicles). The local Boy Scouts and the City of Redmond have an ongoing program to clean up the caves site. The Boy Scouts have adopted the Redmond caves under the BLM's Adopt-an-Open Space program. However, the degradation of the caves site appears to be occurring at the same pace or more rapidly than clean up.

Potential Use

The goal of this Master Plan is to guide the public towards better stewardship of the caves with security and appropriate facilities, and through education. If the Master Plan implementation is successful, the *number* of people using the caves site may increase over the present levels of use. However, the *types* of uses would be changed to reduce impacts.

The caves would be managed in a manner consistent with the Federal Cave Resources Protection Act. As directed by the Act, implementing the Master Plan would result in securing, protecting, and preserving cave resources for the perpetual use, enjoyment, and benefit of all people. Management of the site as proposed would maintain the existing biological, cultural, geological, recreational, and educational values.



also BLM

The Caves site is currently in poor condition... If the Master Plan implementation is successful, the *number* of people using the Caves site may increase over the present levels of use. However, the *types* of uses would be changed to reduce impacts.

Should be protected, mitigation enhance values.

There are several important constraints to the use of the site. The foremost of these is the cave protection zone, defined as a 350-foot buffer around all cave openings and known cave passages. Under the Interim Management Policy, new surface-disturbing activities that would adversely impact any significant cave resource values are prohibited within this zone.

The Oregon Department of Transportation (ODOT) has been evaluating routes for a proposed bypass of Highway 97 for the City of Redmond. One potential route for the bypass intersects the northwest corner of the caves site. ODOT may submit a right-of-way application to BLM in the future. Environmental analysis would include an assessment of impacts to significant cave resources. Any authorized construction activities would be required to avoid adverse impacts to these resources.

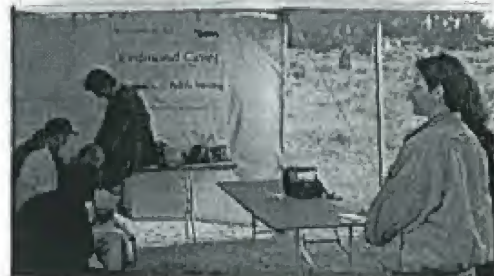
Development of the caves site as a public park would be designed to maintain the natural character of the site and promote the principles of good cave stewardship. Pavement within the protection zone would be limited to a fully-accessible road/trail (see Section 5: Site Plan). No pavement or permanent structures would be placed within the sinkholes. Other than the accessible trail, trails within the protection zone would be natural soil surface, unless dust abatement or increased visitor use requires the placement of natural materials such as bark chips or gravel. Irrigation would be limited to a distance greater than 350 feet from all known cave openings and passages and roads designed to not affect surface runoff into the caves. Construction activities would be timed so as to not impact any remaining bat populations. The caves would be monitored for impacts.

A number of appropriate uses for the caves site have been identified. The particulars of these proposed components are described in Sections 4, 5, and 6.

- ❖ Picnic area and gathering spot;
- ❖ Passive recreation such as walking, caving, bird-watching;
- ❖ Interpretive education including signs, kiosks, special trails, guided walks, outdoor classroom to teach good outdoor and cave behavior and the importance of protecting natural [REDACTED];
- ❖ Open space for surrounding industrial area; and
- ❖ Ancillary attraction to the County Fairgrounds.

350' buffer around caves
No disturbances that would adversely
impact cave significance.

Welcome to the Redmond Caves



Construction activities
would have to avoid impacts to
cave significance.

Irrigation system is probably
not a good idea on the 40-acre
cave parcel because of potential
percolation / infiltration into
caves!!

impacts

impacts

impacts

REDMOND CAVES MASTER PLAN

JANUARY 11, 1999

Section 5

Site Plan

The Site Plan (Figure 3) reflects the overall goal of the project to protect the site and guide proper usage. The Site Plan includes the following elements:

- ❖ **Fencing.** In order to control motor vehicle access, the entire site would be fenced. Fencing is proposed to be a combination of split rail in areas where aesthetics are more important, and less expensive 3-strand wire fence along other portions of the site. All fencing would meet BLM specifications to reduce conflicts with wildlife. The bottom rail or strand would be a minimum of 18 inches above the ground and the top rail or strand would be a maximum of 38 inches. The central rail or wire would be at 26 inches for a three-strand or rail fence. If a four-strand or rail fence is constructed, the center two rails or strands would be at 24 and 28 inches above the ground. A fencing detail of the split rail is included as Figure 4.
- ❖ **Trails and roads.** For the most part, roads and trails are designed to conform to existing disturbed areas. Trails would be created by narrowing existing dirt roads through rehabilitation. A fully accessible trail would be created to allow wheelchair access to a viewpoint of the central caves. The fully accessible trail would be paved, emergency access road would be graveled, and all other trails would have a natural soil surface in the short-term. As use levels increase, or as needed for dust abatement, trail surfaces could consist of bark chips, gravel, crushed rock, or similar permeable surface.
- ❖ **Parking.** A parking area would be created with access off of 13th Street. The lot would be designed to accommodate both cars and buses. The parking lot would be illuminated as a security measure. The parking area would be paved. Bicycle parking would also be installed in this area, near the restroom.

The Site Plan includes...

- Fencing
- Trails and roads
- Parking
- Restroom
- Picnic area
- Landscaping
- Revegetation
- Natural vegetation management
- Habitat improvements
- Cave rehabilitation
- Entrance monument sign
- Interpretive and directional signs
- Outdoor classroom
- Possible visitor center

BLM Specifications

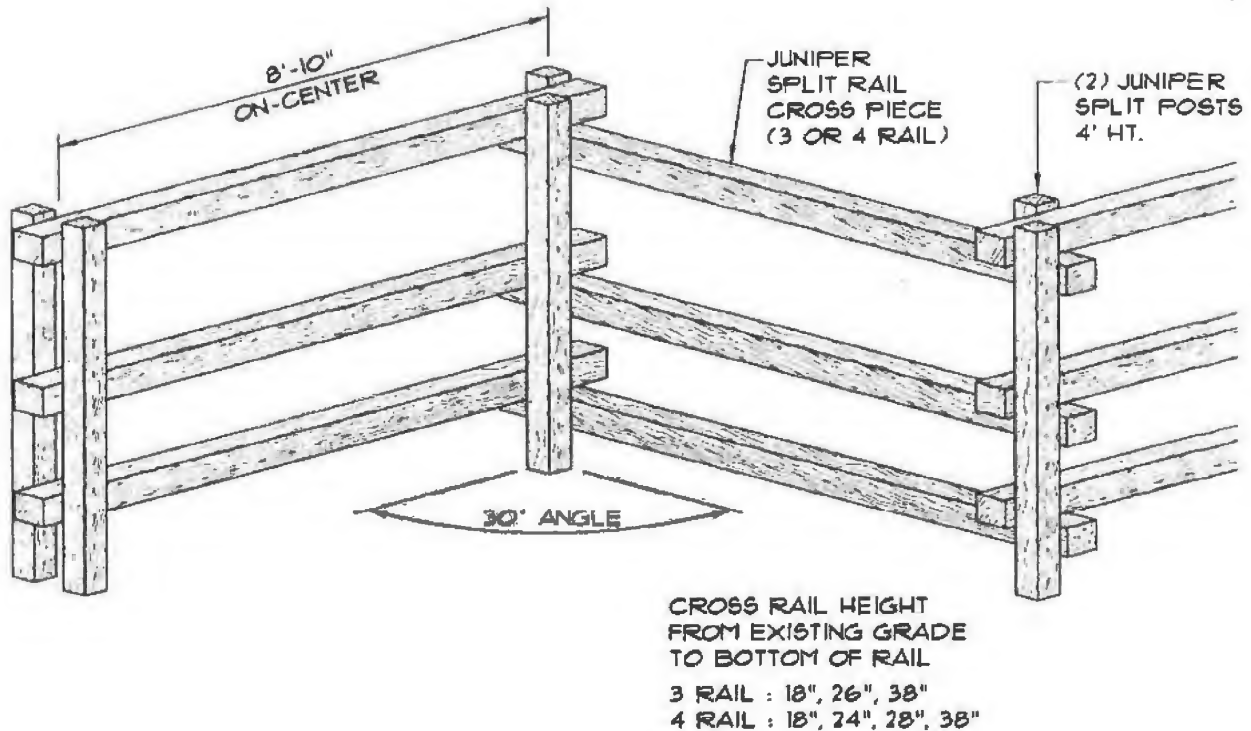
roads & trails using disturbed areas.
ADA paved trail to museum cave
(also emergency vehicle access)
gravel emergency access rd.
(Don't know if we need this)
trails would have a natural soil surface.

inspects

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Figure 4. Zig-Zag Split Rail Fence



- ❖ **Restroom.** Water and sewer are both currently available in 13th Street. A public restroom would be located adjacent to the parking lot. The area around the restroom would be paved. The paved area also provides space for a kiosk or other signage. It is recommended that temporary toilets be installed as soon as the site is signed.
- ❖ **Picnic area.** A picnic ground with turf grass would be installed adjacent to the parking area to provide a play space and picnic spot for visitors and neighboring employees.
- ❖ **Landscaping.** Landscaping in the form of turf grass and trees (a mix of native and non-native species) is proposed for the parking and picnic area to provide shade.
- ❖ **Revegetation.** Revegetation would take place on portions of the site where motor vehicle use has compacted the soil and no trails or roads are intended. The following revegetation method is recommended to narrow existing dirt roads to around 6 feet wide for trails. (Note: It may be appropriate to leave some existing narrower roads "as is" and focus revegetation efforts on larger compacted areas, such as the existing informal parking area.)

probably not a good idea due to water infiltration into Caves.
Ramadas could be constructed to provide shade as opposed to planting trees.

why not rehabilitate both?

This revegetation methodology would also be used on portions of the site that are in poor habitat condition due to invasion by weeds and non-native grasses.

- Field stake location and limits of path or road.
- Disk compacted soils to a depth of 12 inches.
- Install 6-inch layer of crushed gravel within the designated emergency access. Compact to within 95% relative density.
- Install 2 inches of asphaltic concrete to the fully accessible road/trail. (Note: this road/trail would extend to an overlook but would not enter the sinkhole.)
- Rough seed disrupted area adjacent to path or road with native seed mix. Rake seed into top ¼ inch of disked soil. Apply seed during fall season.
- In spring, spot spray or manually remove noxious weeds as soon as identifiable along trails, the emergency access road, and other cleared areas. Overseed bare areas with native seed mix.

❖ *Natural vegetation management.* Areas of natural vegetation would be managed to maintain old growth juniper and native plants within the understory. Thinning of younger juniper may occur to maintain the vigor of the understory and improve the aesthetics of the site.

❖ *Habitat improvements.* Bird and bat boxes may be installed to improve wildlife viewing opportunities.

❖ *Cave rehabilitation.* The following cave rehabilitation measures should be considered:

- Gate both entrances of Cave No. 3 to protect roosting bats, reduce human disturbance and vandalism, and provide an opportunity for education and interpretation. Gating would consist of a Zero Airflow Restriction Bat Gate. The cave could be open seasonally, closed year-round, or used by permitted entry only.
- Remove trash on a regular basis, including small pieces of glass.
- Remove fire rings and smoke marks.
- Evaluate cave interiors for safety on a regular basis (i.e., ceiling stability).

impact negatively arising
clearance / disturbing

impact

impact

impact

2 entrances?

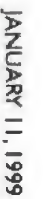
- Following appropriate cultural clearances, excavate the entrance to Cave No. [redacted] to determine the extent of cave passages.
- Monitor geologic features for alteration or damage.
- Remove or cover graffiti. BLM could work with the High Desert Grotto and Central Oregon Task Force to develop a methodology that is effective but does not impact significant cave resources.
- ❖ *Entrance monument sign.* A detail of the proposed sign style is shown on Figure 5.
- ❖ *Interpretive and directional signs.* A detail of the proposed sign style is shown on Figure 5.
- ❖ *Outdoor classroom/lecture area.* A small area of wooden or similar material benches is suggested for construction adjacent to the central cave opening. This location is the most visually interesting portion of the site.
- ❖ In the future, if a *visitor center* is desired, it should be constructed to the south of the rest room.

Because the City of Redmond intends to apply to lease the caves site under the R&PP, the Site Plan would be submitted to BLM with the lease application. The BLM would prepare an environmental assessment for the lease, based on the Site Plan (Figure 3).

Don't know if this is necessary

impact

REDMOND CAVES MASTER PLAN



Security and Maintenance

Security

Site security is an essential component of the proposed park's success. It would be necessary to prevent unauthorized motor vehicle use and illegal activities such as cave bonfires and trash dumping. A number of measures are available to ensure the site's security.

- ❖ *Interim Cave Management Policy.* Enforce restrictions under the Interim Cave Management Policy for BLM Caves in Oregon. The City of Redmond will provide enforcement.
- ❖ *Fencing.* As discussed in Section 4, fencing would be provided around the entire site as a key security step.
- ❖ *Vehicle exclusion.* The parcel should be officially closed to motor vehicle use by the BLM, except for the fully accessible trail/road and the emergency access road.
- ❖ *Regulatory signs.* Once the fencing is in place, signs implementing road closures and other restrictions should be prominently posted.
- ❖ *Hours of operation.* Signs notifying the public of the hours of operation should also be posted immediately. Hours should be limited to dawn until dusk.
- ❖ *Trash pickup.* Having a regular schedule of trash pickup would establish a presence on the site and allow continuous checking for vandalism. Trash cans or dumpsters should be placed on the site when fencing is complete.
- ❖ *Patrol access.* The perimeter of the site would be accessible on public roads or rights-of-way.
- ❖ *Restrooms.* The twice daily presence of a City employee to lock and unlock the public restrooms, as well as regular visits by a maintenance person or crew would provide a presence of authority on the site.

Section 6



? do we want administrative trail use closed to BLM?

entrance gated/locked?

- ❖ *Lighting.* Combined with fencing, the recommended hours of operation for the Redmond caves site would control night use to some extent. However, lighting, especially in the parking and restroom area would increase the security of the area by discouraging loitering and making the site more visible to night patrols. The lighting should be shielded and directed downward to minimize off-sight impacts. Lighting will be limited to the parking and restrooms; no cave entrances will be illuminated.
- ❖ *On-site presence.* A small visitors center or trailer for a volunteer would provide a daytime presence on the site to discourage unwanted activities. If night security becomes a serious concern, the City may want to consider providing water and sewer hookup for a full-time "camp host."
- ❖ *Ongoing maintenance.* It is important to quickly remove graffiti, trash dumps, and fire rings. This sends the message that the site is being regularly monitored and that inappropriate behavior is not tolerated.
- ❖ *Phone number/telephone.* A handout or sign with a phone number to call to report vandalism or suspicious behavior should be provided at the parking area. The City may wish to consider installing a public telephone.

Maintenance

As the site develops, maintenance becomes more complex. Security and facilities to curtail unwanted behavior, as discussed above, would be the first level of effort for the site. Once facilities are constructed, they would need to be maintained. The following activities are expected:

- ❖ Remove trash and graffiti;
- ❖ Maintain fencing;
- ❖ Empty trash cans;
- ❖ Provide dust abatement (water trucks, bark mulch, gravel, etc.) during construction;
- ❖ Maintain trails (replace gravel, control erosion);
- ❖ Maintain and replace plant materials in landscaped and rehabilitated areas;
- ❖ Mow picnic area;
- ❖ Repave and stripe parking lot;

gate & lock the area after hours.

Water trucks could cause infiltration into caves.

impacts

- ❖ Maintain and replace signs and other interpretive materials; and
- ❖ Clean and repair restrooms.

The site plan is designed to make maintenance as efficient as possible. The picnic area and restrooms are located off 13th Street, a developed road, and are relatively close to Airport Way. Maintenance or emergency vehicles would be able to easily access the site via a paved and a graveled road.

In addition to maintenance, other ongoing activities that would be the responsibility of the Redmond Public Works/Parks Division include scheduling activities and managing volunteers
*in consultation with
the BLM.*

Section 7



Interpretive and Educational Program

The Redmond caves site provides a tremendous potential to inform the public. The natural history of the site is rich and diverse, from geology to cultural resources. More importantly, the Redmond caves are already well-known to the public and are located in an urbanizing environment, unlike other more remote and less disturbed Central Oregon caves. Good cave manners, along with an understanding of the damage that abuse can bring, and the importance of preserving cultural resources would be demonstrated here. In particular, the City and BLM wish to use the caves site to teach children respect and affection for the natural environment and cultural resources. Through these activities, other cave sites in Central Oregon can be protected from irresponsible or uneducated behavior.

Organizations such as the NSS, Bat Conservation International, and the American Cave Conservation Association could also supply educational materials and design. The High Desert Grotto could be a source of volunteers for education on caving techniques and safety.

The interpretive and education program should have three components: (1) self-guided; (2) guided, and (3) off-site.

Self-Guided Interpretation

Self-guided interpretation is the simplest and least expensive to provide. Typically, self-guided interpretation does not require staffing, except to provide materials for pickup at the site. The following is a list of the appropriate types of on-site interpretation for the Redmond caves site. It is recommended that the Redmond caves interpretive program start out with some combination of these methods.

- ❖ A simple covered box with *handouts* and a *site register* could be provided at the site entrance. The handout could include

Good cave manners, along with an understanding of the damage that abuse can bring, and the importance of preserving cultural resources would be demonstrated here... The interpretive and education program should have three components:

- self-guided,
- guided, and
- off-site.

the rules of the site, safe caving behavior, information about bats and other wildlife, and phone numbers to contact for more information or to report security or maintenance problems.

- ❖ An *interpretive walk* could be provided on the trail system. This consists of a brochure provided in a covered box at the site entrance that is keyed to numbered posts or other markers on the site. Interpretive walks are less expensive to construct and maintain than permanent interpretive signs, and have the advantage that they could be easily supplied in other languages if appropriate. However, the supply of brochures must be constantly replenished for the walk to be successful. Recycling brochures for use by others should be encouraged. Information could include the following:
 - a narration of lava tube formation,
 - cultural and historical information,
 - the story of the western big-eared bat and bats in general,
 - descriptions of old growth juniper woodland habitat and its associated wildlife,
 - identification of disturbances to the site such as soil compaction,
 - explanations of rehabilitation programs,
 - naming the Cascade peaks visible from the site, and
 - mileage of each trail segment.
- ❖ *Permanent interpretive signs* could be installed at the entrance to the site and at key locations within the site. The permanent signs could include the same type of information as the handout and interpretive walk brochure; however, they have the advantage of not being tied to a particular point. Permanent signs provide a sense of place to a park and could be very attractive. However, they are relatively expensive to install and are susceptible to vandalism.

Guided Interpretation

Guided interpretation typically requires someone to be present on the site to provide information. The following is a list of appropriate types of on-site interpretation for the Redmond caves site:

- ❖ A small *visitor center* could be built near the entrance. A park host (typically a volunteer) could be stationed at the center to answer questions and provide a measure of security.

resources that were here of significance to tribes & why.

moxens weeds? where they came from, how they got here

The center could also house displays, provide brochures, and update a bulletin board of upcoming events. Less attractive, but functional, a small trailer could be parked on the site to provide the same services. }

- ❖ Regular *guided walks* could be provided on the site. These could be conducted by trained volunteers. For example, during the summer months, a guided walk could be held every Saturday morning. The emphasis should be on providing information beyond that easily included in a brochure or on a sign. Examples of this type of information appropriate to the Redmond caves site include interpretive walks on seasonal flowering plants, old growth juniper woodland, and backyard wildlife. Other appropriate walks would teach visitors how to cave properly.
- ❖ Local experts could deliver *talks or lectures* on appropriate topics such as geology, bats, or native plants.
- ❖ More intensive *classes* (lasting several hours) could be provided on caving, geology, biology, botany, or crafts. Such projects as building bat or bird houses could take place at the outdoor education area.
- ❖ The public could be invited to participate in *rehabilitation* activities, such as learning how to plant native vegetation and restore caves site.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



Off-Site Interpretation and Education

- ❖ *Off-site interpretation* typically provides interesting information with the intent of attracting visitors to the site. For the Redmond caves site, appropriate locations for displays and brochures include the Redmond Airport, Library, Chamber of Commerce, City Hall, and the Deschutes County Fairgrounds.
- ❖ *Off-site education* typically focuses on an in-school program that provides classroom education to children as preparation for field trips. The Redmond caves site provides the opportunity to teach students about local geology, history, cultural resources, cave protection, and wildlife (especially bats). Perhaps most importantly, the caves site could be a place for children to learn to appreciate and respect natural and cultural resources. A significant benefit of this is that children often influence parental behavior with these learned values.

tribal values

Development Schedule

Table 1 describes a timeline to guide the funding and development process of the Redmond caves site over the next 20 years. The items are in rough chronological order.

Table 1. Schedule of Improvements

TASK	November	December	January	February	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	1998	1999	2000	2005	2010	2015
Final Public Meeting																				
Adopt Master Plan																				
Submit lease application to BLM																				
Conduct archaeological survey																				
EAF/ONSI																				
Install perimeter fence																				
Request closure of site to motor vehicles																				
Post regulatory signs																				
Place box for park rules & info handouts																				
Place temporary restroom facility																				
Place monument sign																				
Place info about park in off-site locations																				
Build parking lot																				
Build internal roads/trails																				
Initiate rehabilitation of compacted areas																				
Install irrigation/landscaping/turf (picnic area)																				
Install parking lot lighting																				
Install self-guided walk (posts, brochure)																				
Construct permanent restrooms																				
Install telephone																				
Build outdoor classroom																				
Install permanent interpretive signs																				
Install temporary visitors center (trailer)																				
Build permanent visitors center																				

Accuracy is not consistent with preceding task.

Section 9

Cost Estimates and Funding Sources

Table 2 includes cost estimates for the proposed elements of the Redmond Caves Master Plan.

Table 2. Park Improvement Cost Estimates

IMPROVEMENT ¹	PER UNIT COST ²	TOTAL
Fence		
1,830 linear feet (LF) wood rail	\$5/LF	\$9,150
2,960 LF wire fence	\$1.50/LF	\$4,440
Road		
300 LF paved (14' wide; 2" AC over 4" base)	\$20/LF	\$6,000
500 LF gravel (14' wide; 6" depth)	\$15/LF	\$7,500
Revegetation		
40,200 square feet (SF) ripped, amended, planted)	\$0.25/SF	\$10,050
Parking Area		
43,053 SF paved (2" AC over 6" base)	\$1.30/SF	\$60,000
Striping		\$450
5,000/LF curb and sidewalk	\$12/LF	\$60,000
Drainage (2 drywells)	\$4,000 ea	\$8,000
4,000 SF landscaping	\$1.50/SF	\$6,000
Lighting (5 lights)	\$1000 ea	\$5,000
Signs		
Regulatory (8 signs)	\$200 ea	\$1,600
Monument sign		\$2,500
Posts (8 posts for self-guided walk)	\$10 ea	\$80
Permanent interpretive (5 signs)	\$400 ea	\$2,000
Picnic Area		
60,806 SF lawn (seeded)	\$0.15/SF	\$9,120
64,806 SF Irrigation (lawn & parking)	\$1.50/SF	\$97,200
Picnic tables (three tables)	\$350 ea	\$1,050
Trash cans (three 50-gallon)	\$500 ea	\$1,500
Other landscaping (15 trees)	\$85 ea	\$1,275
Restroom		
Building		\$75,000
2,500 SF pavers	\$3/SF	\$7,500
250' water line	\$45/LF	\$11,250
250' sewer line	\$40/LF	\$10,000
250' power line	\$22/LF	\$5,500
Visitor Center		
200 SF wood structure, concrete foundation	\$85/SF	\$17,000
TOTAL COST OF IMPROVEMENTS		\$501,249

1. Cost estimates include labor. The use of volunteers could significantly reduce costs.

2. Costs of completing additional inventories identified in Section 3 are not included in this table.

Funding Sources

In order to finance the recommended park improvements, it is important to consider a range of funding sources. The use of alternative revenue funding has been a trend throughout Oregon as the full implementation of Measure 5 has reduced property tax revenues. This trend has continued with the passage of Measures 47 and 50. This overview is provided to illustrate the range of options currently available to finance Redmond caves site improvements over the next 20 years.

Property Taxes

Property taxes have traditionally served as the primary revenue source for local governments. Property taxes could be levied through: (1) tax base levies, (2) serial levies, and (3) bond levies. The most common method uses tax base levies that do not expire and are allowed to increase by 6% per annum. Serial levies are limited by amount and time they could be imposed. Bond levies are for specific projects and are limited by time based on the debt load of the local government or the project.

System Development Charges

System Development Charges (SDCs) can be used to fund public infrastructure, especially as growing populations increase demand. Generally, the objective of SDCs is to allocate portions of the costs associated with capital improvements upon the developments which increase demand on park, sewer or other infrastructure systems. The City of Redmond has a SDC system in place that currently collects fees for City parks. A portion of this funding could be allocated to the Redmond caves site.

Grants and Loans

The majority of the grant and loan programs available today are geared towards economic development. Most federal programs require a match from the local jurisdiction as a condition of approval. Private grant programs are a potential source of funding for the portions of the Master Plan that are tied to educational programs. Some programs may be also be appropriate for capital improvements.

Federal Grant Programs

The most promising of federal programs is the Land and Water Conservation Fund (L&WCF), which was established in 1964 (Public Law 88-578) and is effective through September 30, 2015. The L&WCF is a type of "trust fund" to accumulate revenues

from Federal outdoor recreation user fees, the Federal motorboat fuel tax, surplus property sales, and oil and gas leases on the Outer Continental Shelf, for subsequent appropriation by Congress. Fund grants have averaged around \$100 million per year over the life of the program, with a peak of \$369 million in FY 1979.

The L&WCF was established for two primary purposes. The majority of expenditures have been for land acquisition and associated management costs by the four major Federal land management agencies: the USDA Forest Service, and the National Park Service, U.S. Fish and Wildlife Service, and Bureau of Land Management in the Department of the Interior.

To be eligible for grants, every State must prepare and regularly update a statewide recreation plan and a project selection process. In most years, States receive apportionments of L&WCF grant funds based on a national formula (with state population being the most influential factor). Then States initiate a statewide competition for the amount available. Applications are scored and ranked according to the project selection criteria so that only the top-ranked projects (up to the total amount available that year) are chosen for funding. 'Winning' applications are then forwarded to the National Park Service for formal approval and obligation of federal grant monies.

The State office supplies local application deadlines, state priorities and selection criteria, and direction on the documentation required to justify a grant award. The Oregon office is located at: Policy & Planning Division, Dept. of Parks & Recreation, 1115 Commercial St., N.E, Salem OR 97310-1001, 503-378-6378.

Private Foundations

There are a number of foundations in the state that provide funding for community-based project, particularly those that focus on educational programs. These foundations require that an applicant have nonprofit status; in Redmond, this could be accomplished by the formation of a "Friends of Redmond Caves" organization. The following is a list of the Oregon-based foundations that have historically supported education, youth activities, community improvement, and wildlife protection.

- ❖ The Autzen Foundation, Portland
- ❖ James A. Bonavia Family Charitable Trust, Bend
- ❖ Clark Foundation, Portland

- ❖ Chiles Foundation, Portland
- ❖ Jeld-Wen Foundation, Klamath Falls
- ❖ Pacificorp Foundation, Portland

Financing Tools

In addition to *funding* options, the recommended park improvements listed in this plan may benefit from a variety of *financing* options. Although often used interchangeably, the terms financing and funding are not the same. Funding is the actual generation of revenue by which a jurisdiction pays for improvements, such as property taxes, SDCs, and various grant programs. Financing refers to the collecting of funds through debt obligations.

There are a number of debt financing options available to the City of Redmond, all of which could be used to pay for cave site improvements. The use of debt to finance capital improvements is balanced with the ability to make future debt service payments and to deal with the impact on its overall debt capacity and underlying credit rating. Debt financing should be viewed not as a source of funding, but as a time shifting of funds. The use of debt to finance these park improvements is appropriate since the benefits from the park improvements would extend over the period of years. If such improvements were to be tax financed immediately, a large short-term increase in the tax rate would be required. By utilizing debt financing, local governments are essentially spreading the burden of the costs of these improvements to more of the people who are likely to benefit from the improvements and lowering immediate payments.

General Obligation Bonds

General obligation (GO) bonds are voter-approved bond issues which represent the least expensive borrowing mechanism available to municipalities. GO bonds are typically supported by a separate property tax levy specifically approved for the purposes of retiring debt. The levy does not terminate until all debt is paid off. The property tax levy is distributed equally throughout the taxing jurisdiction according to assessed value of property. General obligation debts are typically used to make public improvement projects that would benefit the entire community.

State statutes require that the general obligation indebtedness of a city not exceed 3% of the real market value of all taxable property in the city. Since general obligation bonds would be issued subsequent to voter approval, they would not be restricted to the limitations set forth in Ballot Measures 5, 47, and 50.

Although new bonds must be specifically voter approved, Measure 47 and 50 provisions are not applicable to outstanding bonds, unissued voter-approved bonds, or refunding bonds.

Limited Tax Bonds

Limited tax general obligation bonds (LTGOs) are similar to general obligation bonds in that they represent an obligation of the municipality. However, a municipality's obligation is limited to its current revenue sources and is not secured by the public entity's ability to raise taxes. As a result, LTGOs do not require voter approval. However, since the LTGOs are not secured by the full taxing power of the issuer, the limited tax bond represents a higher borrowing cost than general obligation bonds. The municipality must pledge to levy the maximum amount under constitutional and statutory limits, but not the unlimited taxing authority pledged with GO bonds. Because LTGOs are not voter approved, they are subject to the limitations of Ballot Measures 5, 47, and 50.

Bancroft Bonds

Under Oregon Statute, municipalities are allowed to issue Bancroft bonds which pledge the city's full faith and credit to assessment bonds. As a result, the bonds become general obligations of the city but are paid with assessments. Historically, these bonds provided a city with the ability to pledge its full faith and credit in order to obtain a lower borrowing cost without requiring voter approval. However, since Bancroft bonds are not voter approved, taxes levied to pay debt service on them are subject to the limitations of Ballot Measures 5, 47, and 50. As a result, since 1991, Bancroft bonds have not been used by municipalities who were required to compress their tax rates.

Volunteers

A program to recruit and manage volunteers is recommended for the Redmond caves site, both to reduce costs and to increase community ownership of the site. Individuals and groups could purchase and install specific items such as fencing, benches, picnic tables, signs, and even trail segments. Some of these items could be named after a group or individual. Several Central Oregon natural areas have had great success with this type of volunteer activity, such as the Sunriver Nature Center. For example, the local gardening club or native plant society chapter could build and maintain a native plant walk. Volunteers could increase security on the site by leading on-site walks and staffing a temporary or permanent information booth.

General service groups who may be willing to donate time or materials are the local Rotary and Kiwanis Clubs, Boy Scouts, Campfire, Redmond Senior Center. Some special interest groups in the area that may be willing to provide volunteers include the High Desert Grotto (caving technique and safety), Native Plant Society (vegetation), Audubon Society (birds and wildlife). Organizations such as the NSS, Bat Conservation International, and the American Cave Conservation Association could also supply educational materials and design.

An effective way to attract and manage volunteers is to form a "Friends of the Redmond Caves" advisory committee for the park. The City could supply staff and meeting rooms for such a group. If the group could qualify for nonprofit status, it could apply for grants from foundations to build and manage the Redmond caves.

Appendix A: Interim Cave Management Policy

INTERIM CAVE MANAGEMENT POLICY FOR
BUREAU OF LAND MANAGEMENT (BLM) CAVES IN OREGON AND WASHINGTON

Introduction

The Federal Cave Resources Protection Act of 1988 states that significant caves on federal lands are an invaluable and irreplaceable part of the Nation's natural heritage and, in some instances, these significant caves are threatened due to improper use, increased recreational demands, urban spread, and lack of specific statutory protection.

The Act's purposes are to secure, protect and preserve significant caves on federal lands for the perpetual use, enjoyment and benefit of all people and to foster increased cooperation and exchange of information between governmental authorities and those who utilize caves located on federal lands for scientific, educational or recreational purposes.

As provided by the Act, it is also the policy of the United States that federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves.

Recently issued federal regulations define the process and criteria for establishing cave significance. In accordance with the Act, federal agencies are required to prescribe policy or regulation which include management measures to insure that caves under consideration for listing of significance be protected during the period of consideration. The Act further provides for agencies to regulate or restrict use, as appropriate for caves determined to be significant.

Until caves are determined significant and management plans are prepared which provide specific management prescriptions for those caves, the following interim policy will insure the protection of significant and potentially significant caves on federal lands administered by the BLM in Oregon and Washington.

Interim Cave Management Policy

1. Recreational or other human activities are allowed in caves when consistent with protecting other cave resource values. Foot access and exploration in caves is permissible, unless otherwise limited.
2. Where known or potential adverse impacts from human use to threatened, endangered, and/or sensitive plants or animals, cultural resources, biological deposits (i.e. middens, skeletal remains, etc.), or geologic/paleontologic/mineral features are present, then the responsible authorized officer shall act to protect these resources. Such actions could include information/education, closures (seasonally or yearlong), written authorization for activities, or other appropriate measures.

3. In administratively and Congressionally designated areas, authorized officers will continue to apply existing applicable agency direction when such direction provides sufficient protection of significant or potentially significant caves (i.e. federal laws, regulations, resource management plans, interim management guidelines for wilderness study areas, or cave management plans).
4. Written authorization will be required from the responsible authorized officer for any activity or installation that could destroy, disturb, deface, mar, alter, harm, remove cave resources or alter the free movement of life into or out of any significant or potentially significant cave. This could include recreational, scientific, educational, commercial or competitive uses. Written authorization can be in the form of an approved Management Plan, use permit or authorizing letter.
5. The BLM retains the authority to limit or terminate uses and/or require the restoration of cave resources if it is determined that unacceptable resource damage is occurring.
6. The BLM will consider proposals for special activities at any time, including placing fixed anchors in a cave, establishing a trail to a cave, research, etc. For existing uses or activity proposals where it is determined that a Management Plan is required, priority will be given to caves where extensive recreational uses are occurring or significant resource conflicts may be at issue.
7. Authorized activities or installations are subject to the agency's NEPA process and shall be consistent with the intent of the Federal Cave Resources Protection Act of 1988 and any conditions of existing policy and/or management decisions for the affected cave(s). Written authorization would require the applicant to provide the time, scope, location and specific purpose of the proposed activity and the manner in which the activity is to be performed.
8. Unless otherwise authorized, the following acts are prohibited in all caves. The responsible authorized officer will take appropriate action needed to reduce or eliminate the occurrence of the acts.
 - * Willfully defacing, removing or destroying plants or their parts, soil, rocks or minerals, or cave resources
 - * Building, maintaining, attending or using a fire, campfire or stove fire
 - * Smoking
 - * Camping
 - * Possessing, discharging or using any kind of fireworks or other pyrotechnic device
 - * Discharging a firearm, air rifle or gas gun
 - * Possessing a domestic animal
 - * Disposing human waste
 - * Digging, excavation, or displacement of natural and/or cultural features

- * Removal of cave resources
 - * Entering into a cave which requires written authorization, or engaging in any activities for which a written authorization requirement has been established, without having obtained in advance and having in possession such written authorization
9. Existing installations (i.e. stairs, ladders, fixed anchors, etc.) will be evaluated for retention or removal. Retained and future installations designed and authorized to be left in place should normally be camouflaged to minimize visual impacts. Method of removal or future placement will be pre-approved by the authorized officer and a condition of written authorization. Any non-permanent apparatus or equipment used must be removed immediately after its use.
 10. The use of hand drying agents for climbing which are not natural appearing will be avoided. Mitigation measures (chalk balls, pigmented chalk, etc.) will be required, should monitoring indicate the need to reduce visual impacts to a cave. If needed, periodic cleaning of drying agents by cave users to the satisfaction of the authorized officer can be required.
 11. On public lands administered by the Bureau of Land Management, no new surface disturbing activities would be authorized within a 350 foot radius of a cave opening or any known cave passages which may adversely impact any significant or potentially significant cave resource value.

AGREEMENT

This agreement is by and between the City of Redmond ("City") and the Bureau of Land Management ("BLM").

WITNESSETH

WHEREAS, The City and the BLM recognize that the Redmond Caves ("Caves") is a valuable natural, cultural and recreational resource for City, region and State; and

WHEREAS, The City and BLM have determined it is advantageous to both parties and in the public interest to enter into this agreement; and

WHEREAS, The City and BLM agree that there is a need to preserve the cultural and natural resources of the Redmond Caves. It is also agreed that neither the City nor the BLM has the resources to preserve the site or to develop interpretive or recreational facilities. However, the City and BLM agree that by combining the energies of staff, land, equipment, and volunteer resources that the Caves's cultural and natural resources can be preserved and enjoyed with a minimum of costs. Therefore, the City and BLM agree to the following conditions to preserve and enhance the Redmond Caves Site.

NOW, THEREFORE, in consideration of the foregoing, the parties hereto agree as follows:

Bureau of Land Management Obligations:

1. The BLM will agree to joint management of Caves preservation and educational programs with the City.
2. The BLM will agree to coordinate mitigation and preservation efforts at the Caves.

City Obligations:

1. The City will prepare a master plan map of the site including identification of the cave sites, proposed trails and parking area.
2. The City will commit City staff to assist in the development and maintenance of the Caves site.
3. The City will pursue grants and donations to develop and preserve the site.
4. The City will coordinate the utilization of volunteers, docents and teachers for interpretive programs at the site.

not let in stone.

5. The City will pursue redesignation of zoning from manufacturing to Open Space Park land.
6. The City will provide law enforcement patrol of the Redmond Caves.

Mutual Obligations:

1. BLM and the City will develop an access plan for the use and preservation of the Caves.
2. BLM and the City will develop a master plan for the site which will include use policies and a schedule and budget for site improvements.
3. The BLM and City will develop educational, environmental, cultural and recreational public classes.
4. BLM and the City will attempt to develop appropriate interpretive displays of Caves history [REDACTED] on site or in (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)
5. BLM and the City will develop a cooperative project plan for implementation of the various actions identified.

Termination:

Either party may terminate this agreement by providing the other party 120 days written notice of its intent.

DATED this 27th day of October 1992.

BUREAU OF LAND MANAGEMENT

CITY OF REDMOND

By: 

By: 

Appendix B: Bibliography

APPENDIX B: REDMOND CAVES BIBLIOGRAPHY

Brookout, John. 1965. *Named Caves of Oregon*.

Bureau of Land Management. Memorandum from Sarah Nichols to Jim McKenna, Deschutes Area Manager, May 30, 1997.

“Could Caves of Northwest Shelter Future War Plants?” *The Oregonian*, Magazine Section, March 2, 1947. Page 4.

“Central Oregon Lava Caves.” *California Caves*, Vol. 3 No. 4, 1951. Page 4.

Chamberlin, Joseph C. 1962. “New and Little Known False Scorpions, Principally from Caves, Belonging to the Family *Chthoniidae* and *Neobisiidae*.” *American Museum of Natural History Bulletin*, Vol. 123, No. 6. Pages 303-352.

“Current status of Speleology in Oregon.” *Cascade Cave Report*, No. 3, 1951. Page 2.

Howell, Donna, Dr., et al. [date?] “Draft Management Guidelines for Known Sites of the Big-Eared Bat (*Plectorius townsendii*) within the Range of the Northern Spotted Owl.”

Jordan, Lucille. 1954. Lions Club Discovers Third Cave in Redmond Area: Sand and Pumice Barrier Removed From Entrance. *The Oregonian*, April 11. Page 32.

Knutson, Richard S. [date?]. “The Caves of Deschutes County, Oregon.” Western Speleological Society; Spring 35a.

Larson, Charles V. 1977. Bibliography of Region Speleology, Bulletin 6; Oregon Speleological Survey Serial #55.

Log of Speleological Society. *Bulletin of National Speleological Society*, No. 4, 1942. Pages 55-63.

Perkins, Mark. (1998). “Results of Mist Netting and Bat Trapping at Redmond Caves and Selected Mine Sites for Prineville Bureau of Land Management, Prineville, Oregon, Summer 1998. Pacific Northwest Bat Research Team, 2217 E. Emerson, Salt Lake City, UT 84108.

Unpublished map of the Redmond Caves, March 28, 1969.. In Oregon Grotto Library.

“Western Caves Currently Under Consideration as Fallout Shelters.” *Western Speleological Survey Bulletin*, No. 11, 1963. Western Speological Society.

Redmond Caves Master Plan

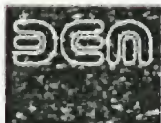
(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

October 29, 1998



Prepared by



DAVID EVANS AND
ASSOCIATES, INC.

for the



in cooperation
with the



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The Master Plan was created with the guidance and review of the **Redmond Caves Grant Team**:

City of Redmond

Mary Meloy Director Public Works

Helen Moor Public Involvement, Public Works

Don Cooper Park Division, Public Works

Bureau of Land Management

Sara Nichols Wildlife Biologist

Ron Gregory, Deschutes Area Archaeologist

U.S. Forest Service

Karen Bushnell Jones Public Affairs Specialist

Section I

Site Description and Background

Background

The Redmond caves site encompasses a (b) (5) Cultural Resources area of natural lava tube caves and native juniper woodland (Figure 1). The property is currently owned by the Bureau of Land Management (BLM) but (b) (5) Cultural Resources Redmond's city limits. (b) (5) Cultural Resources (NPSA & Sec. 106)

Eventually, the caves site will be surrounded by light industrial uses. The new Deschutes County Fairgrounds are currently being built less than a mile to the south.

The Redmond caves have been listed as *significant* under the Federal Cave Resources Protection Act (FCRP) due to their cultural, recreational, biological, and educational resource values. The caves site is currently managed under the FCRP and the Interim Cave Management Policy for BLM Caves in Oregon (Appendix A).

The Bureau of Land Management (BLM) and the City of Redmond have entered into a joint agreement to manage the Redmond caves site as a public park with an emphasis on education. This agreement commits the City to prepare a Master Plan that describes how best to rehabilitate, preserve, and maintain the resources of the Redmond caves site. The City plans to submit a lease application to BLM under the Recreation and Public Purposes Act (see discussion below).

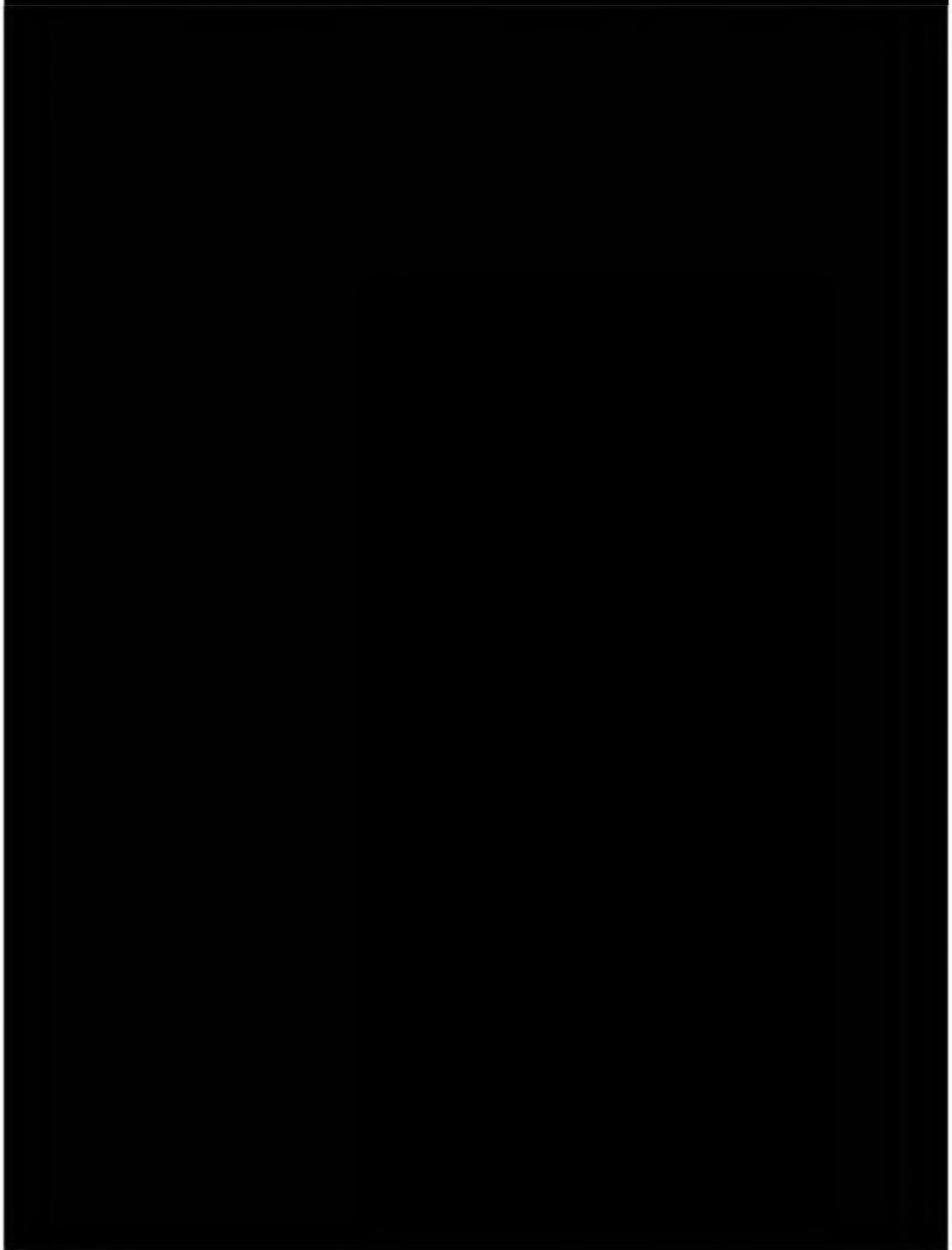
The Redmond caves site is an unique asset for the City of Redmond and Central Oregon because it is very accessible and located near an urban area. The caves site provides a very attractive opportunity for interpretation, education, and recreation. However, rehabilitation efforts are needed to repair and keep up with the high levels of damage from ongoing misuse of the site.



The Redmond Caves have been listed as *significant* under the Federal Cave Resources Protection Act due to their cultural, recreational, biological, and educational resource values.

Figure 1. Site Location Map

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



Because of unregulated access and the resultant vandalism, the caves are currently relatively unsafe and unattractive for the general public, especially children. Graffiti, broken glass, and smoke stains from illegal campfires are present in all of the caves. At the present time, the local Boy Scouts and the City of Redmond are continuing a clean-up program of the caves site.

The goal of this Master Plan is to establish basic guidelines for development and management of the site. The emphasis is on providing opportunities for the public to learn appropriate caving behavior and the resource values associated with Oregon's lava tube caves. In particular, the participants in this planning effort hope that the Redmond caves site could be used to teach the public good safety and preservation behaviors that would help protect more remote and less disturbed caves. The challenge is to develop a Master Plan that would rehabilitate, protect, and manage the caves site for both recreation and education. Most importantly, the Master Plan must be feasible to implement.

The emphasis is on providing opportunities for the public to learn appropriate caving behavior and the resource values associated with Oregon's lava tube caves.

Objectives

As established by BLM and the City of Redmond, the objectives of the Master Plan are the following:

1. Identify management strategies to rehabilitate and enhance the caves and their surrounding environment consistent with the Federal Cave Resources Protection Act for the protection of significant cave resources (the caves were listed as significant in 1995);
2. Limit the degradation of the caves, soils, and vegetation that results from uncontrolled human access;
3. Maintain the caves, trails, and other facilities in accordance with State and Federal requirements to provide a safe and attractive visitor experience; and
4. Implement an interpretive and educational program that protects and highlights the unique, b) (5) Cultural Resources (ARPA & IS) biological, and geological attributes of the caves.

Recreation and Public Purposes Act

This Master Plan will be used in the application process defined in the Recreation and Public Purposes Act (R&PP), under which the City of Redmond would apply to lease the caves site from the BLM. Land included in R&PP applications for leases must be shown to be part of a definite, well-planned project with specific purposes to benefit the public. A development and management plan is required. As identified in the R&PP guide, the master plan must include the following elements:

1. *A statement of the proposed use of the lands, a detailed description of the proposed project, and a statement describing administration of the tract* (Sections 1, 4, 5, 6 and 7).
2. *The anticipated expenditure for development (including source of funds to be used for development)* (Section 9).
3. *A map showing the nature and location of facilities, land ownership of the entire project, and access routes* (Section 5).
4. *Timetable for development* (Section 8).
5. *Explanation of proposed maintenance responsibilities and procedures* (Section 6).

In addition, this plan includes a summary of existing information (Section 2), identifies information gaps (Section 3), and describes the existing and potential use of the site (Section 4).

Public Involvement

A Redmond Caves Grant Team consisting of BLM, US Forest Service (USFS), the City of Redmond, and the consultant was established to guide and monitor the Caves Master Plan. The Caves Team met ___ times over the course of the project.

Two public meetings were held. The first was in June, 1998. This meeting was held on-site and included a guided cave visit as well as background information. Over 100 people attended this first meeting. The second public meeting was held in November, 1998 to present the draft Master Plan. Approximately ___ people attended the second meeting.

An on-site meeting with Klamath, Burns-Paiute, and Confederated Tribes of Warm Springs was held on June 8, 1998. Approximately 20 people attended. The meeting was an opportunity to begin to share the Tribes' oral history about the caves site and to get their impressions on the best ways to manage the area. It was at this meeting that a possible name for the future park was mentioned. According to Bridget Whipple, staff to the Warm Springs Culture and Heritage Committee, *Tuulí Pušpuš Pa* is the Sahaptin name used by elders to describe the Redmond caves site. The name appears to be particularly appropriate to the caves site. Permission to use this name should be requested from the Confederated Tribes of Warm Springs Reservation of Oregon.



Tuulí Pušpuš Pa is the Sahaptin name used by elders to describe the Redmond Caves site.

Review of Existing Information

As part of the background research for the Caves Master Plan, queries were made of local and regional libraries, historical societies, experts, interest groups, and agencies. The Redmond caves have long been of interest to a wide variety of people, including native people, settlers, residents, cavers, and naturalists. However, there is not a great deal of information reflected in available historical and academic literature. For example, although general information related to lava tube formation is very accessible, specific references to the formation of the Redmond caves complex are rare.

Sources consulted during background research included the following:

- ❖ Central Oregon Community College Library;
- ❖ Internet;
- ❖ University of Oregon Library;
- ❖ BLM files;
- ❖ Deschutes County Historical Society;
- ❖ Redmond Historical Commission;
- ❖ Oregon Headquarters of the National Speleological Society (NSS);
- ❖ The High Desert Grotto (Central Oregon Chapter of the NSS); and
- ❖ On-site meeting with regional Tribal representatives.

A bibliography of the information located is listed in Appendix B. This information would be useful in developing the text for the interpretive program (see Section 7, Interpretation and Education).

Section 2



It should also be noted that valuable information regarding the caves site may be held by individuals and groups who have used, visited, and explored the caves site over the years. This is particularly true for the Confederated Tribes of Warm Springs, whose elders have a strong oral tradition.

The following section includes a brief summary of information pertaining to the site, gathered from the resources identified during research for this project.

Cultural Resources

The Redmond caves have long been known as a source of (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA). The caves provided temporary shelter, and possibly a summer water source (in the form of ice). The Redmond caves were officially recorded as an archaeological site in 1983. Local newspaper accounts, BLM minerals reports, and correspondence between the BLM and National Park Service report (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA).

For this Master Plan, Dr. John Fagan of Archaeological Investigations Northwest, Inc. conducted an analysis of the caves site, including a literature search, records review, and a pedestrian reconnaissance-level survey (Appendix C). (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA).

Data gaps should be filled by formulating a research design that includes conducting a thorough cultural resources survey of the parcel, implementing a site testing plan, and evaluating site significance against National Register of Historic Places criteria. Additional measures would include developing a plan to protect and preserve significant cultural resources. It would also be important to consult with local Tribal governments to determine if the caves site has value as a Traditional Cultural Property.

Wildlife and Habitat

The caves site and BLM public lands surrounding Redmond and Bend are characterized by old growth juniper woodlands. The old growth juniper woodlands are a unique habitat type, since

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

less than 3% of all juniper woodlands in Oregon are characterized by trees older than 100 years. In the spring and summer, old growth juniper woodlands support a high diversity of breeding bird species. In the winter, the woodlands typically support large flocks of songbirds.

With the increasing urban population, the environment has been altered in both the caves and the surrounding area. Levels of disturbance have increased as a result of unregulated recreation, nearby industrial uses, and vehicle traffic. Off-road vehicle use and road construction have resulted in pockets of weeds and non-native vegetation. Some native wildlife species have also been displaced by human presence and disturbance. Although a variety of wildlife species can still be observed on the site, over time the area will increasingly favor "urban" or "backyard" wildlife.

The site's small size (b) (5) Cultural Resource and its location (b) (5) Cultural Resource the city limits, surrounded by private light industrial use, also limits wildlife diversity.

Bats

The northwestern population of the big-eared bat (*Corynorhinus townsendii*) is a U.S. Fish and Wildlife Service *Species of Concern* and a BLM *Sensitive Species*. The big-eared bat is state listed in Oregon as *Sensitive-Critical*. BLM field inventories of the Redmond caves have recorded very small numbers of western big-eared bats. Field studies conducted from 1986 to 1995 have located from one to three bats using the caves for hibernation (winter roosting). Accounts from local residents suggest that the caves had "many" bats in the past. It is likely that these reports are true, and that the Redmond caves historically supported a much larger colony of western big-eared bats.

All bats are easily disturbed by human presence, and the western big-eared bat is known to be particularly sensitive to disturbance. The main threat to this species has been the disturbance of roosting sites from recreational caving or any other activity that involves human entry, noise, or vibration. Surveys conducted in Oregon indicate that many historic roost sites have been negatively impacted in recent years. Most monitored colonies have had moderate to sizable reduction in numbers.

The Redmond caves continue to have the potential to provide winter or summer roosting habitat for bat species other than the western big-eared bat. Current use is limited by human visitation, but the BLM has documented small numbers of big brown bats (*Eptesicus fuscus*) and small-footed myotis (*Myotis*



ciliolabrum) using the site for night roosting during the summer (Perkins, 1998). Based on current biological information, use of the caves for daytime recreation and education would likely not affect the remaining bat populations, particularly if activities cease at dusk as recommended (see Section 5).

Redmond Caves Site False-Scorpion

An article in the *American Museum of Natural History Bulletin* (Number 123, 1962), describes a holotype (only known example of a species) of Charlotte's false-scorpion (*Parobisium charlotteae*) as having been collected in June 1938 from the "Redmond lava cave." It is likely that this is a reference to the Redmond caves; however, the 1962 description of the insect was from the 1938 collection housed at the American Museum of Natural History and the location derived from original field notes.

The Charlotte's false-scorpion is described as large and reddish brown in color. It is also described as blind or semi-blind, which may indicate that the species is found only in caves. Little else is known about the insect. If additional efforts have been undertaken to locate representatives of the Charlotte's false-scorpion, no records were made. If the false-scorpion is present in the Redmond caves, and is indeed a rare species, it may be considered Threatened or Endangered. At the least, the record of the species is an interesting addition to the natural history of the caves.

Geology

Like many of the geologic features of Central Oregon, the Redmond caves site complex was formed by volcanic flows from the Newberry Caldera, a shield volcano around 35 miles south of the caves site. The Redmond area is covered by a layer of volcanic flow called Newberry Basalt, typically 50 to 100 feet thick, that originated on the flanks of Newberry Caldera during the Pleistocene Epoch (around 10,000 to 2 million years ago). It is expected that the Newberry Basalt is relatively thick in the caves area, probably around 100 feet. Near the surface, the Newberry Basalt hosts many lava tubes, including the Redmond caves system. In most places, the basalt is covered with a thin layer of windblown sand and silt.

As the Newberry Caldera repeatedly erupted, the downslope flows created tubes that carried the hot fluid lava through areas that had cooled and hardened. Lava tubes became plugged as lava cooled, and new tubes formed. At times, the tubes emptied of lava. Some of the empty tubes subsequently collapsed and are



visible today as topographic depressions. Others are now lava tube caves.

The Redmond caves complex consists of five known caves. Most are relatively shallow, although two of the caves are joined by a narrow connection. The caves have deep, sandy floors, with scattered fallen ceiling blocks. The complex is virtually one lava tube, with individual "caves" separated by roof collapse. The dimensions of the caves range from 60 feet wide and 20 feet tall to 10 feet wide and 2 feet tall. Many passages have been filled with sand that has blown in. The smaller caves are suspected to be as large as the main passages, if the blow sand were to be excavated. The large caves have floors consisting of blow sand and pumice dust at least 6 to 8 feet deep. Because of this, the caves are very dusty when disturbed.

The caves have been reported to extend beyond the BLM property onto private property. A 1963 BLM Mineral Report mentions that local residents entered a cave on private property to the northeast of the subject property, crawled in a southwesterly direction, and exited at another cave opening. The report also mentions that the same residents crawled from the lumber yard entrance in a northwesterly direction for approximately 600 feet. The entrance was apparently in the middle of a lumber yard, and was filled. According to the mineral report, the entrance to Cave No. [REDACTED] (Figure 2) was blasted closed by dynamite for "...no apparent reason..." This cave remains closed by fill.

The Redmond Caves complex consists of five known caves... The possibility remains that undiscovered lava tubes are present on the site.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Redmond Caves

Deschutes County, Oregon

Figure 2. Cave Locations

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)



0 50 100



Scale Feet

Legend

Breakdown

Sand

Ceiling Height

Slope

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Note: Caves are shown in approximate relationship as mapped by Global Positioning System (GPS).

Cave survey by the members of the Oregon High Desert Grotto
of the National Speleological Society, Bend, Oregon.
For more info contact the N.S.S. at 2813 Cave Ave, Huntsville, AL 35810

Additional Inventory Needs

The literature search and interviews conducted for this Master Plan revealed several deficiencies. A general description of appropriate methodology is included. A recommended schedule for completion of these additional inventories is included in Section 8.

Some of these topics may be excellent senior or masters degree projects for college students. The City may wish to contact the Central Oregon Community College and institutions such as the University of Oregon to establish the feasibility of using students to provide additional inventory information for the site, especially for more academic components, such as the search for the Charlotte's false-scorpion.

Cultural Resources

- ❖ Conduct a onetime systematic archaeological and cultural survey of the entire (b) (5) Cultural Resources parcel that includes recordation of all sites and isolates. Site boundaries would be fully delineated and documented during the course of the survey. All cultural clearances would be completed before ground-disturbing activities.
- ❖ Shovel test sites only when necessary to determine National Register of Historic Places eligibility.
- ❖ Evaluate sites for significance using National Register of Historic Places criteria.
- ❖ If necessary, develop a research design for data recovery. The design must meet State Historic Preservation Office (SHPO) and BLM approval.
- ❖ Determine the site's potential as a Traditional Cultural Property. Designation of Traditional Cultural Properties located on public lands must have SHPO concurrence.
- ❖ Record an oral history of the caves site from testimony provided by tribal elders and longtime residents of Redmond.

Some of these topics may be excellent senior or masters degree projects for college students...

- Record an oral history.
- Monitor bat use.
- Search for Charlotte's false-scorpion.
- Search for additional lava tube caves.
- Count users.

Wildlife

- ❖ Continue to monitor bat use via existing BLM methodology. This consists of a diurnal (daytime) examination for winter roosting bats every one to two years, and summer surveys including visual and electronic detection.
- ❖ Conduct a search for the Charlotte's false-scorpion. Methodology for this search should be established by an entomologist.

Geology

- ❖ Conduct a site survey to locate any additional lava tube caves on-site. Methodology for this survey should be determined by the BLM. Methods used by Siemans and Associates (1996) for the 13th Street alignment is one technique to be considered.

Recreation

- ❖ It would be beneficial for planning and funding purposes to better understand how many people are currently using the caves site for recreation. This could be accomplished by a weekend and weekday count during the summer when use is likely to be the highest. Even if this is not feasible, counts should be made periodically as improvements are installed in the new park.

Section 4

Existing and Potential Public Use

Existing Use

The Redmond caves site has long been used by local residents for cave exploration, off-highway driving, walking, shooting, and as an informal gathering spot. The caves site has also been the site of illegal activities such as (b) (5) Cultural Resources (NHPA & Sec. 304) and refuse dumping. Several generations of locals have visited the site for these and other reasons.

The caves site is currently in poor condition. The caves and soils do not appear to be supporting the current types of use (mainly off-highway vehicles). The local Boy Scouts and the City of Redmond have an ongoing program to clean up the caves site. The Boy Scouts have adopted the Redmond caves under the BLM's Adopt-an-Open Space program. However, the degradation of the caves site appears to be occurring at the same pace or more rapidly than clean up.

Potential Use

The goal of this Master Plan is to guide the public towards better stewardship of the caves with security and appropriate facilities, and through education. If the Master Plan implementation is successful, the *number* of people using the caves site may increase over the present levels of use. However, the *types* of uses would be changed to reduce impacts.

The caves would be managed in a manner consistent with the Federal Cave Resources Protection Act. As directed by the Act, implementing the Master Plan would result in securing, protecting, and preserving cave resources for the perpetual use, enjoyment, and benefit of all people. Management of the site as proposed would maintain the existing biological, cultural, geological, recreational, and educational values.



The Caves site is currently in poor condition... If the Master Plan implementation is successful, the *number* of people using the Caves site may increase over the present levels of use. However, the *types* of uses would be changed to reduce impacts.

Section 5

Site Plan

The Site Plan (Figure 3) reflects the overall goal of the project to protect the site and guide proper usage. The Site Plan includes the following elements:

- ❖ *Fencing.* In order to control motor vehicle access, the entire site would be fenced. Fencing is proposed to be a combination of split rail in areas where aesthetics are more important, and less expensive 3-strand wire fence along other portions of the site. All fencing would meet BLM specifications to reduce conflicts with wildlife. The bottom rail or strand would be a minimum of 18 inches above the ground and the top rail or strand would be a maximum of 38 inches. The central rail or wire would be at 26 inches for a three-strand or rail fence. If a four-strand or rail fence is constructed, the center two rails or strands would be at 24 and 28 inches above the ground. A fencing detail of the split rail is included as Figure 4.
- ❖ *Trails and roads.* For the most part, roads and trails are designed to conform to existing disturbed areas. Trails would be created by narrowing existing dirt roads through rehabilitation. A fully accessible trail would be created to allow wheelchair access to a viewpoint of the central caves. The fully accessible trail would be paved, emergency access road would be graveled, and all other trails would have a natural soil surface in the short-term. As use levels increase, or as needed for dust abatement, trail surfaces could consist of bark chips, gravel, crushed rock, or similar permeable surface.
- ❖ *Parking.* A parking area would be created with access off of 13th Street. The lot would be designed to accommodate both cars and buses. The parking lot would be illuminated as a security measure. The parking area would be paved. Bicycle parking would also be installed in this area, near the restroom.

The Site Plan includes...

- Fencing
- Trails and roads
- Parking
- Restroom
- Picnic area
- Landscaping
- Revegetation
- Natural vegetation management
- Habitat improvements
- Cave rehabilitation
- Entrance monument sign
- Interpretive and directional signs
- Outdoor classroom
- Possible visitor center

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

SITE STATISTICS

TRAIL TOTAL	6100 LF: (40200 SF)
NEW DISTURBED AREAS FOR TRAILS, PARKING, & OUTDOOR CLASSROOM	74700 SF
14' PAVED ROAD	350 LF: (4900 SF)
14' GRAVEL ROAD	500 LF: (7000 SF)
WOOD RAIL FENCE	1830 LF
WIRE FENCE	2960 LF
PARKING AREA	43053 SF
LAWN AREA	60806 SF

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

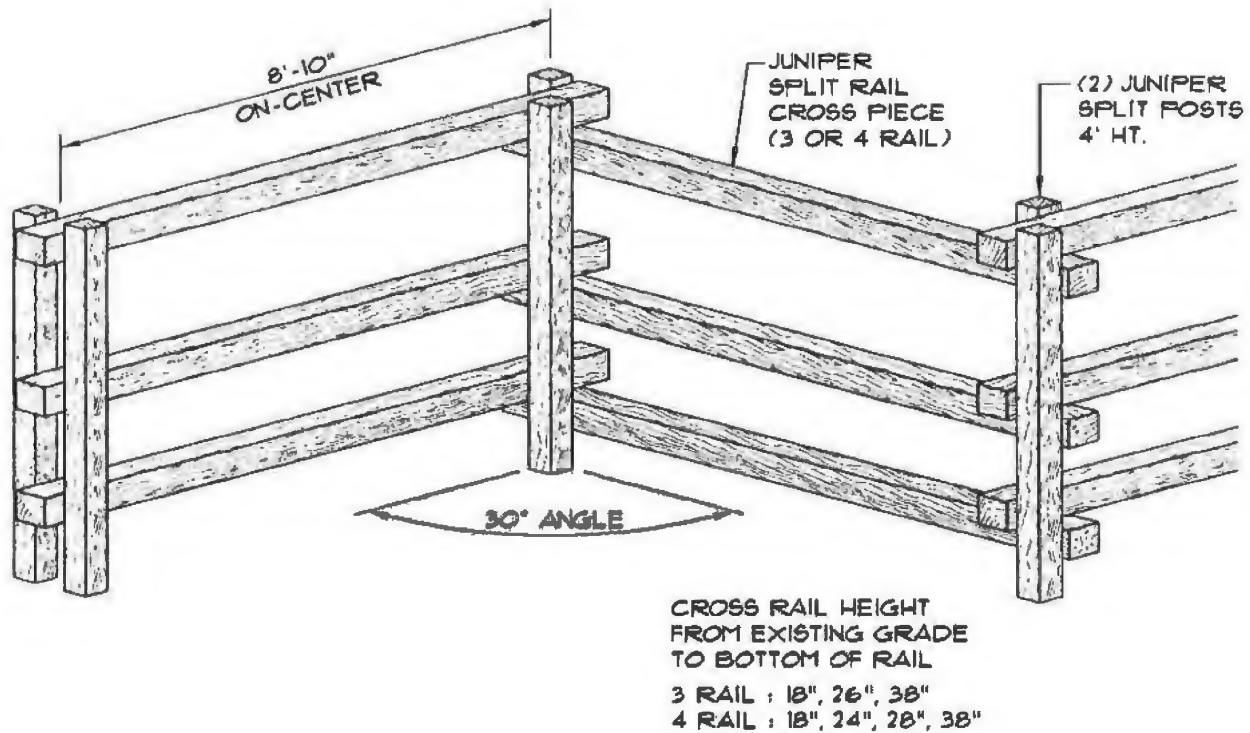


REDMOND CAVES MASTERPLAN

DAVID EVANS AND ASSOCIATES, INC.
700 NW WALL STREET, SUITE 100
SEASIDE, OREGON 97138
503.734.1111



Figure 4. Zig-Zag Split Rail Fence



- ❖ **Restroom.** Water and sewer are both currently available in 13th Street. A public restroom would be located adjacent to the parking lot. The area around the restroom would be paved. The paved area also provides space for a kiosk or other signage. It is recommended that temporary toilets be installed as soon as the site is signed.
- ❖ **Picnic area.** A picnic ground with turf grass would be installed adjacent to the parking area to provide a play space and picnic spot for visitors and neighboring employees.
- ❖ **Landscaping.** Landscaping in the form of turf grass and trees (a mix of native and non-native species) is proposed for the parking and picnic area to provide shade.
- ❖ **Revegetation.** Revegetation would take place on portions of the site where motor vehicle use has compacted the soil and no trails or roads are intended. The following revegetation method is recommended to narrow existing dirt roads to around 6 feet wide for trails. (Note: It may be appropriate to leave some existing narrower roads "as is" and focus revegetation efforts on larger compacted areas, such as the existing informal parking area.)

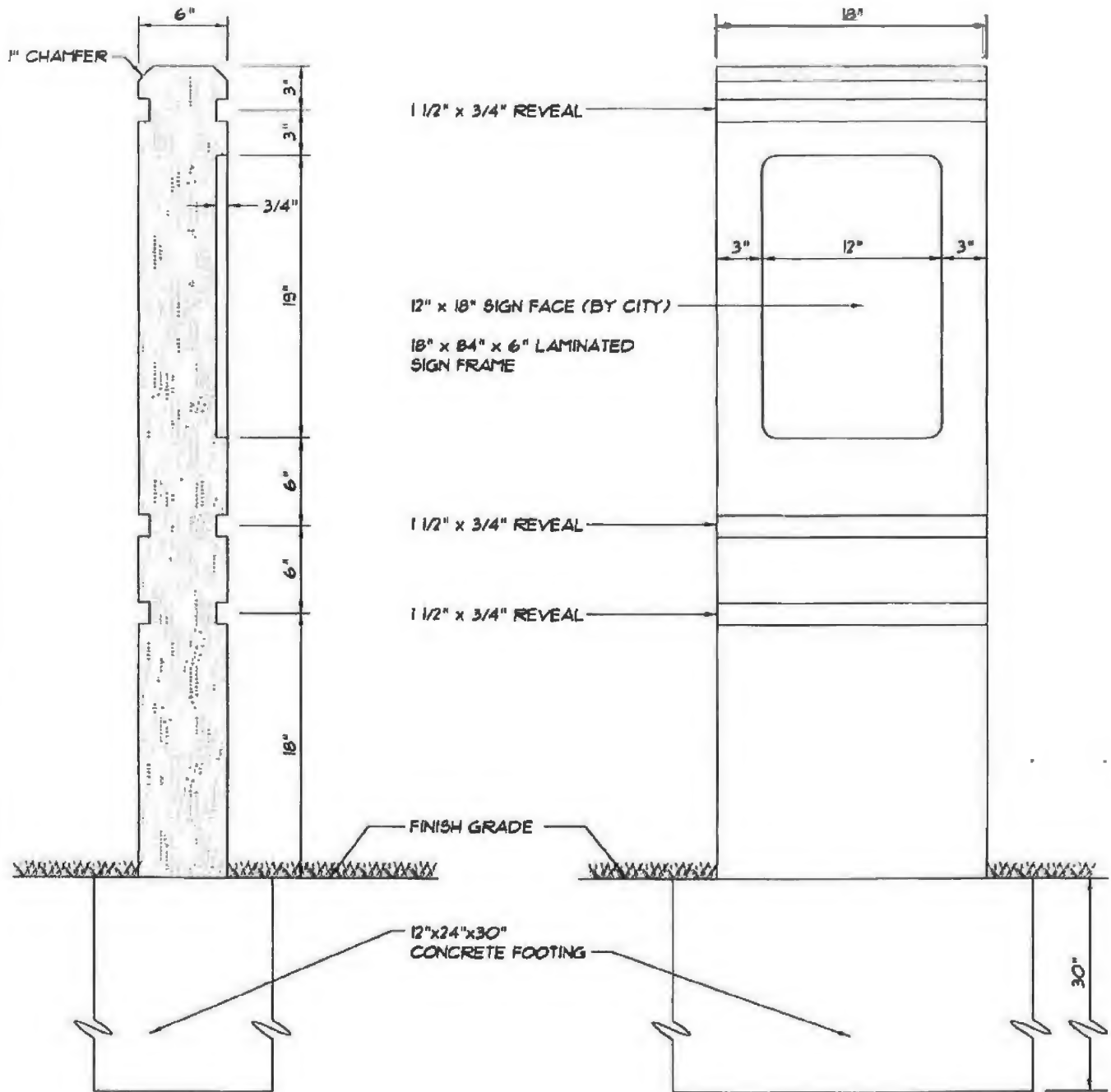
This revegetation methodology would also be used on portions of the site that are in poor habitat condition due to invasion by weeds and non-native grasses.

- Field stake location and limits of path or road.
- Disk compacted soils to a depth of 12 inches.
- Install 6-inch layer of crushed gravel within the designated emergency access. Compact to within 95% relative density.
- Install 2 inches of asphaltic concrete to the fully accessible road/trail. (Note: this road/trail would extend to an overlook but would not enter the sinkhole.)
- Rough seed disrupted area adjacent to path or road with native seed mix. Rake seed into top ¼ inch of disked soil. Apply seed during fall season.
- In spring, spot spray or manually remove noxious weeds as soon as identifiable. Overseed bare areas with native seed mix.
- ❖ *Natural vegetation management.* Areas of natural vegetation would be managed to maintain old growth juniper and native plants within the understory. Thinning of younger juniper may occur to maintain the vigor of the understory and improve the aesthetics of the site.
- ❖ *Habitat improvements.* Bird and bat boxes may be installed to improve wildlife viewing opportunities.
- ❖ *Cave rehabilitation.* The following cave rehabilitation measures should be considered:
 - Gate both entrances of Cave No. 3 to protect roosting bats, reduce human disturbance and vandalism, and provide an opportunity for education and interpretation. Gating would consist of a Zero Airflow Restriction Bat Gate. The cave could be open seasonally, closed year-round, or used by permitted entry only.
 - Remove trash on a regular basis, including small pieces of glass.
 - Remove fire rings and smoke marks.
 - Evaluate cave interiors for safety on a regular basis (i.e., ceiling stability).
 - Remove blow sand from blocked or constricted cave passages.

- Monitor geologic features for alteration or damage.
- Remove or cover graffiti. BLM could work with the High Desert Grotto and Central Oregon Task Force to develop a methodology that is effective but does not impact significant cave resources.
- ❖ *Entrance monument sign.* A detail of the proposed sign style is shown on Figure 5.
- ❖ *Interpretive and directional signs.* A detail of the proposed sign style is shown on Figure 5.
- ❖ *Outdoor classroom/lecture area.* A small area of wooden or similar material benches is suggested for construction adjacent to the central cave opening. This location is the most visually interesting portion of the site.
- ❖ In the future, if a *visitor center* is desired, it should be constructed to the south of the rest room.

Because the City of Redmond intends to apply to lease the caves site under the R&PP, the Site Plan would be submitted to BLM with the lease application. The BLM would prepare an environmental assessment for the lease, based on the Site Plan (Figure 3).

Figure 5. Interpretive Sign Standard



Security and Maintenance

Security

Site security is an essential component of the proposed park's success. It would be necessary to prevent unauthorized motor vehicle use and illegal activities such as cave bonfires and trash dumping. A number of measures are available to ensure the site's security.

- ❖ *Interim Cave Management Policy.* Enforce restrictions under the Interim Cave Management Policy for BLM Caves in Oregon.
- ❖ *Fencing.* As discussed in Section 4, fencing would be provided around the entire site as a key security step.
- ❖ *Vehicle exclusion.* The parcel should be officially closed to motor vehicle use by the BLM, except for the fully accessible trail/road and the emergency access road.
- ❖ *Regulatory signs.* Once the fencing is in place, signs implementing road closures and other restrictions should be prominently posted.
- ❖ *Hours of operation.* Signs notifying the public of the hours of operation should also be posted immediately. Hours should be limited to dawn until dusk.
- ❖ *Trash pickup.* Having a regular schedule of trash pickup would establish a presence on the site and allow continuous checking for vandalism. Trash cans or dumpsters should be placed on the site when fencing is complete.
- ❖ *Patrol access.* The perimeter of the site would be accessible on public roads or rights-of-way.
- ❖ *Restrooms.* The twice daily presence of a City employee to lock and unlock the public restrooms, as well as regular visits by a maintenance person or crew would provide a presence of authority on the site.

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- ❖ *Lighting.* Combined with fencing, the recommended hours of operation for the Redmond caves site would control night use to some extent. However, lighting, especially in the parking and restroom area would increase the security of the area by discouraging loitering and making the site more visible to night patrols. The lighting should be shielded and directed downward to minimize off-sight impacts. Lighting will be limited to the parking and restrooms; no cave entrances will be illuminated.
- ❖ *On-site presence.* A small visitors center or trailer for a volunteer would provide a daytime presence on the site to discourage unwanted activities. If night security becomes a serious concern, the City may want to consider providing water and sewer hookup for a full-time "camp host."
- ❖ *Ongoing maintenance.* It is important to quickly remove graffiti, trash dumps, and fire rings. This sends the message that the site is being regularly monitored and that inappropriate behavior is not tolerated.
- ❖ *Phone number/telephone.* A handout or sign with a phone number to call to report vandalism or suspicious behavior should be provided at the parking area. The City may wish to consider installing a public telephone.

Maintenance

As the site develops, maintenance becomes more complex. Security and facilities to curtail unwanted behavior, as discussed above, would be the first level of effort for the site. Once facilities are constructed, they would need to be maintained. The following activities are expected:

- ❖ Remove trash and graffiti;
- ❖ Maintain fencing;
- ❖ Empty trash cans;
- ❖ Provide dust abatement (water trucks, bark mulch, gravel, etc.) during construction;
- ❖ Maintain trails (replace gravel, control erosion);
- ❖ Maintain and replace plant materials in landscaped and rehabilitated areas;
- ❖ Mow picnic area;
- ❖ Repave and stripe parking lot;

- ❖ Maintain and replace signs and other interpretive materials; and
- ❖ Clean and repair restrooms.

The site plan is designed to make maintenance as efficient as possible. The picnic area and restrooms are located off 13th Street, a developed road, and are relatively close to Airport Way. Maintenance or emergency vehicles would be able to easily access the site via a paved and a graveled road.

In addition to maintenance, other ongoing activities that would be the responsibility of the Redmond Public Works/Parks Division include scheduling activities and managing volunteers.

Interpretive and Educational Program

The Redmond caves site provides a tremendous potential to inform the public. The natural history of the site is rich and diverse, from geology to cultural resources. More importantly, the Redmond caves are already well-known to the public and are located in an urbanizing environment, unlike other more remote and less disturbed Central Oregon caves. Good cave manners, along with an understanding of the damage that abuse can bring, and the importance of preserving cultural resources would be demonstrated here. In particular, the City and BLM wish to use the caves site to teach children respect and affection for the natural environment and cultural resources. Through these activities, other cave sites in Central Oregon can be protected from irresponsible or uneducated behavior.

Organizations such as the NSS, Bat Conservation International, and the American Cave Conservation Association could also supply educational materials and design. The High Desert Grotto could be a source of volunteers for education on caving techniques and safety.

The interpretive and education program should have three components: (1) self-guided; (2) guided, and (3) off-site.

Self-Guided Interpretation

Self-guided interpretation is the simplest and least expensive to provide. Typically, self-guided interpretation does not require staffing, except to provide materials for pickup at the site. The following is a list of the appropriate types of on-site interpretation for the Redmond caves site. It is recommended that the Redmond caves interpretive program start out with some combination of these methods.

- ❖ A simple covered box with *handouts* could be provided at the site entrance. The handout could include the rules of the

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Good cave manners, along with an understanding of the damage that abuse can bring, and the importance of preserving cultural resources would be demonstrated here... The interpretive and education program should have three components:

- self-guided,
- guided, and
- off-site.

site, safe caving behavior, information about bats and other wildlife, and phone numbers to contact for more information or to report security or maintenance problems.

- ❖ An *interpretive walk* could be provided on the trail system. This consists of a brochure provided in a covered box at the site entrance that is keyed to numbered posts or other markers on the site. Interpretive walks are less expensive to construct and maintain than permanent interpretive signs, and have the advantage that they could be easily supplied in other languages if appropriate. However, the supply of brochures must be constantly replenished for the walk to be successful. Recycling brochures for use by others should be encouraged. Information could include the following:
 - a narration of lava tube formation,
 - cultural and historical information,
 - the story of the western big-eared bat and bats in general,
 - descriptions of old growth juniper woodland habitat and its associated wildlife,
 - identification of disturbances to the site such as soil compaction,
 - explanations of rehabilitation programs,
 - naming the Cascade peaks visible from the site, and
 - mileage of each trail segment.
- ❖ *Permanent interpretive signs* could be installed at the entrance to the site and at key locations within the site. The permanent signs could include the same type of information as the handout and interpretive walk brochure; however, they have the advantage of not being tied to a particular point. Permanent signs provide a sense of place to a park and could be very attractive. However, they are relatively expensive to install and are susceptible to vandalism.

Guided Interpretation

Guided interpretation typically requires someone to be present on the site to provide information. The following is a list of appropriate types of on-site interpretation for the Redmond caves site:

- ❖ A small *visitor center* could be built near the entrance. A park host (typically a volunteer) could be stationed at the center to answer questions and provide a measure of security.

The center could also house displays, provide brochures, and update a bulletin board of upcoming events. Less attractive, but functional, a small trailer could be parked on the site to provide the same services.

- ❖ Regular *guided walks* could be provided on the site. These could be conducted by trained volunteers. For example, during the summer months, a guided walk could be held every Saturday morning. The emphasis should be on providing information beyond that easily included in a brochure or on a sign. Examples of this type of information appropriate to the Redmond caves site include interpretive walks on seasonal flowering plants, old growth juniper woodland, and backyard wildlife. Other appropriate walks would teach visitors how to cave properly.
- ❖ Local experts could deliver *talks or lectures* on appropriate topics such as geology, bats, or native plants.
- ❖ More intensive *classes* (lasting several hours) could be provided on caving, geology, biology, botany, or crafts. Such projects as building bat or bird houses could take place at the outdoor education area.
- ❖ The public could be invited to participate in *rehabilitation* activities, such as learning how to plant native vegetation and restore caves site.

Off-Site Interpretation and Education

- ❖ *Off-site interpretation* typically provides interesting information with the intent of attracting visitors to the site. For the Redmond caves site, appropriate locations for displays and brochures include the Redmond Airport, Library, Chamber of Commerce, City Hall, and the Deschutes County Fairgrounds.
- ❖ *Off-site education* typically focuses on an in-school program that provides classroom education to children as preparation for field trips. The Redmond caves site provides the opportunity to teach students about local geology, history, cultural resources, cave protection, and wildlife (especially bats). Perhaps most importantly, the caves site could be a place for children to learn to appreciate and respect natural and cultural resources. A significant benefit of this is that children often influence parental behavior with these learned values.

Development Schedule

Table 1 describes a timeline to guide the funding and development process of the Redmond caves site over the next 20 years. The items are in rough chronological order.

Table 1. Schedule of Improvements

TASK	November	December	January	February	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	1998	1999	2000	2005	2010	2015
Final Public Meeting																				
Adopt Master Plan																				
Submit lease application to BLM																				
Conduct archaeological survey																				
EA/FONSI																				
Install perimeter fence																				
Request closure of site to motor vehicles																				
Post regulatory signs																				
Place box for park rules & info handouts																				
Place temporary restroom facility																				
Place monument sign																				
Place info about park in off-site locations																				
Build parking lot																				
Build internal roads/trails																				
Initiate rehabilitation of compacted areas																				
Install irrigation/landscaping/turf (picnic area)																				
Install parking lot lighting																				
Install self-guided walk (posts, brochure)																				
Construct permanent restrooms																				
Install telephone																				
Build outdoor classroom																				
Install permanent interpretive signs																				
Install temporary visitors center (trailer)																				
Build permanent visitors center																				

Section 9

Cost Estimates and Funding Sources

Table 2 includes cost estimates for the proposed elements of the Redmond Caves Master Plan.

Table 2. Park Improvement Cost Estimates

<i>IMPROVEMENT¹</i>	<i>PER UNIT COST²</i>	<i>TOTAL</i>
<i>Fence</i>		
1,830 linear feet (LF) wood rail	\$5/LF	\$9,150
2,960 LF wire fence	\$1.50/LF	\$4,440
<i>Road</i>		
300 LF paved (14' wide; 2" AC over 4" base)	\$20/LF	\$6,000
500 LF gravel (14' wide; 6" depth)	\$15/LF	\$7,500
<i>Revegetation</i>		
40,200 square feet (SF) ripped, amended, planted)	\$0.25/SF	\$10,050
<i>Parking Area</i>		
43,053 SF paved (2" AC over 6" base)	\$1.30/SF	\$60,000
Striping		\$450
5,000/LF curb and sidewalk	\$12/LF	\$60,000
Drainage (2 drywells)	\$4,000 ea	\$8,000
4,000 SF landscaping	\$1.50/SF	\$6,000
Lighting (5 lights)	\$1000 ea	\$5,000
<i>Signs</i>		
Regulatory (8 signs)	\$200 ea	\$1,600
Monument sign		\$2,500
Posts (8 posts for self-guided walk)	\$10 ea	\$80
Permanent interpretive (5 signs)	\$400 ea	\$2,000
<i>Picnic Area</i>		
60,806 SF lawn (seeded)	\$0.15/SF	\$9,120
64,806 SF Irrigation (lawn & parking)	\$1.50/SF	\$97,200
Picnic tables (three tables)	\$350 ea	\$1,050
Trash cans (three 50-gallon)	\$500 ea	\$1,500
Other landscaping (15 trees)	\$85 ea	\$1,275
<i>Restroom</i>		
Building		\$75,000
2,500 SF pavers	\$3/SF	\$7,500
250' water line	\$45/LF	\$11,250
250' sewer line	\$40/LF	\$10,000
250' power line	\$22/LF	\$5,500
<i>Visitor Center</i>		
200 SF wood structure, concrete foundation	\$85/SF	\$17,000
<i>TOTAL COST OF IMPROVEMENTS</i>		\$501,249

1. Cost estimates include labor. The use of volunteers could significantly reduce costs.

2. Costs of completing additional inventories identified in Section 3 are not included in this table.

Funding Sources

In order to finance the recommended park improvements, it is be important to consider a range of funding sources. The use of alternative revenue funding has been a trend throughout Oregon as the full implementation of Measure 5 has reduced property tax revenues. This trend has continued with the passage of Measures 47 and 50. This overview is provided to illustrate the range of options currently available to finance Redmond caves site improvements over the next 20 years.

Property Taxes

Property taxes have traditionally served as the primary revenue source for local governments. Property taxes could be levied through: (1) tax base levies, (2) serial levies, and (3) bond levies. The most common method uses tax base levies that do not expire and are allowed to increase by 6% per annum. Serial levies are limited by amount and time they could be imposed. Bond levies are for specific projects and are limited by time based on the debt load of the local government or the project.

System Development Charges

System Development Charges (SDCs) can be used to fund public infrastructure, especially as growing populations increase demand. Generally, the objective of SDCs is to allocate portions of the costs associated with capital improvements upon the developments which increase demand on park, sewer or other infrastructure systems. The City of Redmond has a SDC system in place that currently collects fees for City parks. A portion of this funding could be allocated to the Redmond caves site.

Grants and Loans

The majority of the grant and loan programs available today are geared towards economic development. Most federal programs require a match from the local jurisdiction as a condition of approval. Private grant programs are a potential source of funding for the portions of the Master Plan that are tied to educational programs. Some programs may be also be appropriate for capital improvements.

Federal Grant Programs

The most promising of federal programs is the Land and Water Conservation Fund (L&WCF), which was established in 1964 (Public Law 88-578) and is effective through September 30, 2015. The L&WCF is a type of "trust fund" to accumulate revenues

from Federal outdoor recreation user fees, the Federal motorboat fuel tax, surplus property sales, and oil and gas leases on the Outer Continental Shelf, for subsequent appropriation by Congress. Fund grants have averaged around \$100 million per year over the life of the program, with a peak of \$369 million in FY 1979.

The L&WCF was established for two primary purposes. The majority of expenditures have been for land acquisition and associated management costs by the four major Federal land management agencies: the USDA Forest Service, and the National Park Service, U.S. Fish and Wildlife Service, and Bureau of Land Management in the Department of the Interior.

To be eligible for grants, every State must prepare and regularly update a statewide recreation plan and a project selection process. In most years, States receive apportionments of L&WCF grant funds based on a national formula (with state population being the most influential factor). Then States initiate a statewide competition for the amount available. Applications are scored and ranked according to the project selection criteria so that only the top-ranked projects (up to the total amount available that year) are chosen for funding. 'Winning' applications are then forwarded to the National Park Service for formal approval and obligation of federal grant monies.

The State office supplies local application deadlines, state priorities and selection criteria, and direction on the documentation required to justify a grant award. The Oregon office is located at: Policy & Planning Division, Dept. of Parks & Recreation, 1115 Commercial St., N.E, Salem OR 97310-1001, 503-378-6378.

Private Foundations

There are a number of foundations in the state that provide funding for community-based project, particularly those that focus on educational programs. These foundations require that an applicant have nonprofit status; in Redmond, this could be accomplished by the formation of a "Friends of Redmond Caves" organization. The following is a list of the Oregon-based foundations that have historically supported education, youth activities, community improvement, and wildlife protection.

- ❖ The Autzen Foundation, Portland
- ❖ James A. Bonavia Family Charitable Trust, Bend
- ❖ Clark Foundation, Portland

- ❖ Chiles Foundation, Portland
- ❖ Jeld-Wen Foundation, Klamath Falls
- ❖ Pacificorp Foundation, Portland

Financing Tools

In addition to *funding* options, the recommended park improvements listed in this plan may benefit from a variety of *financing* options. Although often used interchangeably, the terms financing and funding are not the same. Funding is the actual generation of revenue by which a jurisdiction pays for improvements, such as property taxes, SDCs, and various grant programs. Financing refers to the collecting of funds through debt obligations.

There are a number of debt financing options available to the City of Redmond, all of which could be used to pay for cave site improvements. The use of debt to finance capital improvements is balanced with the ability to make future debt service payments and to deal with the impact on its overall debt capacity and underlying credit rating. Debt financing should be viewed not as a source of funding, but as a time shifting of funds. The use of debt to finance these park improvements is appropriate since the benefits from the park improvements would extend over the period of years. If such improvements were to be tax financed immediately, a large short-term increase in the tax rate would be required. By utilizing debt financing, local governments are essentially spreading the burden of the costs of these improvements to more of the people who are likely to benefit from the improvements and lowering immediate payments.

General Obligation Bonds

General obligation (GO) bonds are voter-approved bond issues which represent the least expensive borrowing mechanism available to municipalities. GO bonds are typically supported by a separate property tax levy specifically approved for the purposes of retiring debt. The levy does not terminate until all debt is paid off. The property tax levy is distributed equally throughout the taxing jurisdiction according to assessed value of property. General obligation debts are typically used to make public improvement projects that would benefit the entire community.

State statutes require that the general obligation indebtedness of a city not exceed 3% of the real market value of all taxable property in the city. Since general obligation bonds would be issued subsequent to voter approval, they would not be restricted to the limitations set forth in Ballot Measures 5, 47, and 50.

Although new bonds must be specifically voter approved, Measure 47 and 50 provisions are not applicable to outstanding bonds, unissued voter-approved bonds, or refunding bonds.

Limited Tax Bonds

Limited tax general obligation bonds (LTGOs) are similar to general obligation bonds in that they represent an obligation of the municipality. However, a municipality's obligation is limited to its current revenue sources and is not secured by the public entity's ability to raise taxes. As a result, LTGOs do not require voter approval. However, since the LTGOs are not secured by the full taxing power of the issuer, the limited tax bond represents a higher borrowing cost than general obligation bonds. The municipality must pledge to levy the maximum amount under constitutional and statutory limits, but not the unlimited taxing authority pledged with GO bonds. Because LTGOs are not voter approved, they are subject to the limitations of Ballot Measures 5, 47, and 50.

Bancroft Bonds

Under Oregon Statute, municipalities are allowed to issue Bancroft bonds which pledge the city's full faith and credit to assessment bonds. As a result, the bonds become general obligations of the city but are paid with assessments. Historically, these bonds provided a city with the ability to pledge its full faith and credit in order to obtain a lower borrowing cost without requiring voter approval. However, since Bancroft bonds are not voter approved, taxes levied to pay debt service on them are subject to the limitations of Ballot Measures 5, 47, and 50. As a result, since 1991, Bancroft bonds have not been used by municipalities who were required to compress their tax rates.

Volunteers

A program to recruit and manage volunteers is recommended for the Redmond caves site, both to reduce costs and to increase community ownership of the site. Individuals and groups could purchase and install specific items such as fencing, benches, picnic tables, signs, and even trail segments. Some of these items could be named after a group or individual. Several Central Oregon natural areas have had great success with this type of volunteer activity, such as the Sunriver Nature Center. For example, the local gardening club or native plant society chapter could build and maintain a native plant walk. Volunteers could increase security on the site by leading on-site walks and staffing a temporary or permanent information booth.

General service groups who may be willing to donate time or materials are the local Rotary and Kiwanis Clubs, Boy Scouts, Campfire, Redmond Senior Center. Some special interest groups in the area that may be willing to provide volunteers include the High Desert Grotto (caving technique and safety), Native Plant Society (vegetation), Audubon Society (birds and wildlife). Organizations such as the NSS, Bat Conservation International, and the American Cave Conservation Association could also supply educational materials and design.

An effective way to attract and manage volunteers is to form a "Friends of the Redmond Caves" advisory committee for the park. The City could supply staff and meeting rooms for such a group. If the group could qualify for nonprofit status, it could apply for grants from foundations to build and manage the Redmond caves.

APPENDIX A: INTERIM CAVE MANAGEMENT POLICY

Instruction Memorandum No. OR-95-021
Effective November 1, 1994

INTERIM CAVE MANAGEMENT POLICY FOR
BUREAU OF LAND MANAGEMENT (BLM) CAVES IN OREGON AND WASHINGTON

Introduction

The Federal Cave Resources Protection Act of 1988 states that significant caves on federal lands are an invaluable and irreplaceable part of the Nation's natural heritage and, in some instances, these significant caves are threatened due to improper use, increased recreational demands, urban spread, and lack of specific statutory protection.

The Act's purposes are to secure, protect and preserve significant caves on federal lands for the perpetual use, enjoyment and benefit of all people and to foster increased cooperation and exchange of information between governmental authorities and those who utilize caves located on federal lands for scientific, educational or recreational purposes.

As provided by the Act, it is also the policy of the United States that federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves.

Recently issued federal regulations define the process and criteria for establishing cave significance. In accordance with the Act, federal agencies are required to prescribe policy or regulation which include management measures to insure that caves under consideration for listing of significance be protected during the period of consideration. The Act further provides for agencies to regulate or restrict use, as appropriate for caves determined to be significant.

Until caves are determined significant and management plans are prepared which provide specific management prescriptions for those caves, the following interim policy will insure the protection of significant and potentially significant caves on federal lands administered by the BLM in Oregon and Washington.

Interim Cave Management Policy

1. Recreational or other human activities are allowed in caves when consistent with protecting other cave resource values. Foot access and exploration in caves is permissible, unless otherwise limited.
2. Where known or potential adverse impacts from human use to threatened, endangered, and/or sensitive plants or animals, cultural resources, biological deposits (i.e. middens, skeletal remains, etc.), or geologic/paleontologic/mineral features are present, then the responsible authorized officer shall act to protect these resources. Such actions could include information/education, closures (seasonally or yearlong), written authorization for activities, or other appropriate measures.

3. In administratively and Congressionally designated areas, authorized officers will continue to apply existing applicable agency direction when such direction provides sufficient protection of significant or potentially significant caves (i.e. federal laws, regulations, resource management plans, interim management guidelines for wilderness study areas, or cave management plans).
4. Written authorization will be required from the responsible authorized officer for any activity or installation that could destroy, disturb, deface, mar, alter, harm, remove cave resources or alter the free movement of life into or out of any significant or potentially significant cave. This could include recreational, scientific, educational, commercial or competitive uses. Written authorization can be in the form of an approved Management Plan, use permit or authorizing letter.
5. The BLM retains the authority to limit or terminate uses and/or require the restoration of cave resources if it is determined that unacceptable resource damage is occurring.
6. The BLM will consider proposals for special activities at any time, including placing fixed anchors in a cave, establishing a trail to a cave, research, etc. For existing uses or activity proposals where it is determined that a Management Plan is required, priority will be given to caves where extensive recreational uses are occurring or significant resource conflicts may be at issue.
7. Authorized activities or installations are subject to the agency's NEPA process and shall be consistent with the intent of the Federal Cave Resources Protection Act of 1988 and any conditions of existing policy and/or management decisions for the affected cave(s). Written authorization would require the applicant to provide the time, scope, location and specific purpose of the proposed activity and the manner in which the activity is to be performed.
8. Unless otherwise authorized, the following acts are prohibited in all caves. The responsible authorized officer will take appropriate action needed to reduce or eliminate the occurrence of the acts.
 - * Willfully defacing, removing or destroying plants or their parts, soil, rocks or minerals, or cave resources
 - * Building, maintaining, attending or using a fire, campfire or stove fire
 - * Smoking
 - * Camping
 - * Possessing, discharging or using any kind of fireworks or other pyrotechnic device
 - * Discharging a firearm, air rifle or gas gun
 - * Possessing a domestic animal
 - * Disposing human waste
 - * Digging, excavation, or displacement of natural and/or cultural features

- * Removal of cave resources
 - * Entering into a cave which requires written authorization, or engaging in any activities for which a written authorization requirement has been established, without having obtained in advance and having in possession such written authorization
9. Existing installations (i.e. stairs, ladders, fixed anchors, etc.) will be evaluated for retention or removal. Retained and future installations designed and authorized to be left in place should normally be camouflaged to minimize visual impacts. Method of removal or future placement will be pre-approved by the authorized officer and a condition of written authorization. Any non-permanent apparatus or equipment used must be removed immediately after its use.
 10. The use of hand drying agents for climbing which are not natural appearing will be avoided. Mitigation measures (chalk balls, pigmented chalk, etc.) will be required, should monitoring indicate the need to reduce visual impacts to a cave. If needed, periodic cleaning of drying agents by cave users to the satisfaction of the authorized officer can be required.
 11. On public lands administered by the Bureau of Land Management, no new surface disturbing activities would be authorized within a 350 foot radius of a cave opening or any known cave passages which may adversely impact any significant or potentially significant cave resource value.

APPENDIX B: BIBLIOGRAPHY

APPENDIX B: REDMOND CAVES BIBLIOGRAPHY

Brookout, John. 1965. *Named Caves of Oregon*.

Bureau of Land Management. Memorandum from Sarah Nichols to Jim McKenna, Deschutes Area Manager, May 30, 1997.

"Could Caves of Northwest Shelter Future War Plants?" *The Oregonian*, Magazine Section, March 2, 1947. Page 4.

"Central Oregon Lava Caves." *California Caves*, Vol. 3 No. 4, 1951. Page 4.

Chamberlin, Joseph C. 1962. "New and Little Known False Scorpions, Principally from Caves, Belonging to the Family *Chthoniidae* and *Neobisiidae*." *American Museum of Natural History Bulletin*, Vol. 123, No. 6. Pages 303-352.

"Current status of Speleology in Oregon." *Cascade Cave Report*, No. 3, 1951. Page 2.

Howell, Donna, Dr., et al. [date?] "Draft Management Guidelines for Known Sites of the Big-Eared Bat (*Plectorus townsendii*) within the Range of the Northern Spotted Owl."

Jordan, Lucille. 1954. Lions Club Discovers Third Cave in Redmond Area: Sand and Pumice Barrier Removed From Entrance. *The Oregonian*, April 11. Page 32.

Knutson, Richard S. [date?]. "The Caves of Deschutes County, Oregon." Western Speleological Society; Spring 35a.

Larson, Charles V. 1977. Bibliography of Region Speleology, Bulletin 6; Oregon Speleological Survey Serial #55.

Log of Speleological Society. *Bulletin of National Speleological Society*, No. 4, 1942. Pages 55-63.

Perkins, Mark. (1998). "Results of Mist Netting and Bat Trapping at Redmond Caves and Selected Mine Sites for Prineville Bureau of Land Management, Prineville, Oregon, Summer 1998. Pacific Northwest Bat Research Team, 2217 E. Emerson, Salt Lake City, UT 84108.

Unpublished map of the Redmond Caves, March 28, 1969.. In Oregon Grotto Library.

"Western Caves Currently Under Consideration as Fallout Shelters." *Western Speleological Survey Bulletin*, No. 11, 1963. Western Speological Society.

APPENDIX C: ARCHEOLOGICAL REPORT

REDMOND CAVES MASTER PLAN

CULTURAL RESOURCES

By

John L. Fagan

Prepared for
David Evans & Associates
Bend, Oregon
and
The City of Redmond

July 17, 1998

Letter Report NO. 223

Archaeological Investigations Northwest, Inc.

2632 S.E. 162nd Ave. • Portland, OR • 97236

Phone (503) 761-6605 • Fax (503) 761-6620

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Introduction

The cultural resources component of the Redmond Caves Mater Plan study has involved a literature search and records review and a pedestrian reconnaissance-level survey of the [REDACTED] parcel containing the Redmond Caves. The 40-acre parcel is federal land under the jurisdiction of the Bureau of Land Management (BLM). The property is situated [REDACTED] the city boundary of Redmond in (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) [REDACTED] (Figure 1). At present, the BLM and the City of Redmond have entered into a joint agreement to manage the caves. The agreement requires that the City prepare a master plan for the caves. The Bend office of David Evans and Associates, Inc. (DEA), has contracted with the City of Redmond to conduct a study of the Redmond Caves project area and to prepare a Master Plan for the project. The cultural resources study was conducted by Archaeological Investigations Northwest, Inc. (AINW), for DEA and the City, and is intended to be incorporated into the Master Plan.

As the BLM is the Nation's principal conservation agency with responsibilities for the management of public lands, it is particularly interested in protecting and preserving archaeological and historical resources as mandated by several federal laws and regulations. Since the caves lie [REDACTED] the City of Redmond, there is an unprecedented opportunity for the City and the BLM to share in the management of the resources for the benefit of the public. The following report provides background information about the cultural resources present on the property and provides recommendations to be incorporated into the Master Plan for management of the potentially significant cultural resources within and around the caves.

Results of Literature Search and Records Review

A review of the State Historic Preservation Office (SHPO) site records indicates that the Redmond Caves [REDACTED] were recorded as an archaeological site in 1983 by R. Lee Lyman during a cultural resource reconnaissance of the nearby Redmond Training Area (Lyman et al. 1983). The site form for [REDACTED] (Lyman 1983) describes the site as consisting of five large lava tube caves with obsidian and cryptocrystalline silicate flakes on the surface outside of the caves. The site form noted that the caves had been "disturbed by [REDACTED] partiers, and sight-seers, etc." In addition, Lyman notes that the site had been tested in 1941 by Robert F. Heizer and that the (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) [REDACTED] were stored at the University of Oregon.

Based on correspondence on file at the BLM Prineville office and newspaper accounts, the Redmond Caves were well known to local spelunkers and [REDACTED] (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) [REDACTED]

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

The (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) [REDACTED] excavated in 1941 at the Redmond Caves by Robert Heizer is curated at the Oregon State Museum of Anthropology at the University of Oregon. On June

3. 1998, I examined and photographed the collection. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

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At various times over the last 50 years there have been several suggested uses for the caves. Proposals ranged from use as a fallout shelter, a tourist attraction, a home for the Deschutes County Historical Society, a mushroom farm, a park, and an archaeological preserve. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Two large-scale archaeological surveys in the Redmond area have provided information about the types of prehistoric sites found in the region. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

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However, there was no information about the number or distribution of sites in the surrounding [REDACTED] parcel. A reconnaissance-level survey of the 4 [REDACTED] parcel was conducted as part of the Master Plan study to determine the potential for discovering prehistoric and historic-period sites in the study area.

Results of Reconnaissance-level Survey

On May 23 and 24, 1998, John L. Fagan and Jo Reese of AINW conducted a pedestrian reconnaissance survey of the [REDACTED] Redmond Caves study area. The surveyors were spaced 10- to 15-meters apart and walked around the perimeter of the study area and back and forth from north to south and east and west across the property. Exposures along dirt roadways radiating out from the center of the property and the areas at the mouths of the caves were also examined for evidence of archaeological resources. Approximately half of the [REDACTED] parcel was examined during the reconnaissance survey.

The survey area is characterized by outcrops of basalt surrounded by pumice and sand that has accumulated in shallow basins. There are five prominent lava tube rockshelters and numerous basalt outcrops in the study area. The vegetation is sparse, including juniper, sagebrush, rabbitbrush, and various forbs and grasses. The ground surface visibility was good with up to 80% of the surface visible. There had been a recent light rain and field conditions were excellent for discovering archaeological materials.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

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The reconnaissance survey also indicated that there is much evidence of recent human use of the project area in the form of modern trash and industrial debris. There are several modern dumps in the project area. A large area at the northwestern corner of the property contains piles of industrial debris, sawdust, pieces of wood, scrap metal, and miscellaneous trash that appears to be from a sawmill. There are several two-track roadways throughout the property that lead to smaller, more recent dumps, and wine and beer bottles and beer cans are scattered throughout the property. Much incidental trash is concentrated around and in the caves.

Data Gaps

The present study has identified several data gaps that need to be filled prior to development of the study area. A cultural resources survey needs to be completed to document the types and locations of archaeological resources on the property outside of the caves.

The property should also be assessed for Native American Traditional Cultural values, and tribal input should be solicited in developing appropriate interpretive and educational programs for the area. Consultation (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) with knowledgeable tribal elders should be conducted to compile useful information about the caves and the study area.

To date there has been no systematic evaluation of the resources within the caves. There have been several reports of unauthorized excavations in the caves, and the integrity of

the remaining deposits need to be assessed. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Management Recommendations

The objectives of the current study were to review existing data and information about the Redmond Caves to provide background and current conditions about cultural resources in the project area. The study was to focus on recommendations to be included in the Master Plan for the study area regarding the types of existing resources and the extent of additional studies needed. Suggested methods of rehabilitating and restoring the area, and suggestions for interpretive and educational use of the caves and surrounding study area are also offered. The following management recommendations are based on the results of the literature search and records review and the on-site reconnaissance-level survey and focus on the resources present in the study area.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) Historic-period resources comprised of (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA) were observed along the southern end of the study area, but they were not abundant. Evidence of modern use is evident in the trash and debris present throughout the study area. This trash detracts from the historical, educational, and interpretive values of the property.

The most appropriate use of the property that would be consistent with cultural resources laws and regulations could best be recommended after additional information about the archaeological resources has been gathered. As noted above, I recommend that the project area be systematically surveyed for archaeological resources. I suggest closely spaced transects no more than 10-meters apart. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Defining characteristics of the resources should be identified so that these values can be taken into account in future development, rehabilitation, or restoration work that is done on the property. (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

The information obtained about Native American use of the caves should be incorporated into interpretive signs and exhibits for public education.

Once the intensive survey has been completed and sensitive areas defined, the modern litter and intrusive industrial debris should be removed from the property.

The area has been impacted by uncontrolled off-road vehicular use. Vehicular access to the area should be restricted and an established parking area should be used to limit ongoing degradation of the property by unrestricted vehicular use of the area.

Restrooms and trash receptacles should be provided near the parking area to control the disposal of trash by visitors.

A trail system from the parking area to the caves and to other points of interest should be developed to maintain the fragile soils and (b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Placement of interpretive signs and/or displays about the history and prehistory of the area is recommended. Information about plants and animals used by Native Americans could

be integrated into the interpretive materials and tied to the natural resources of the study area. Much information about past uses of the caves could be obtained from the (b) (3) Cultural Resources (ARPA) knowledgeable tribal elders.

Archaeological work in the area should include a public archaeology component or a volunteer program to educate the public about the cultural values of the property. Such programs benefit from the input of local people who may become self-appointed stewards of the resources. Based on planning schedules and available funding, a phased approach to the archaeological studies coordinated with other developments within the study area could provide project specific information needed to implement the recommended improvements to the Redmond Caves study area.

(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

Implementation of an interpretive and educational program tied to an interpretive trail and to public exhibits at the City Hall or at other public facilities in Redmond could be used to educate the public about the cultural values of the caves and provide educational opportunities for city park visitors. Use of the area by the public would likely deter vandalism and could contribute to the maintenance and protection of the resources within the study area. Development of a parking area, trails, restrooms, and trash disposal facilities, and regular maintenance of the area would likely prevent misuse of the caves.

References Cited

Ciesiel, Robert F.

1963 *Recreation and Public Purposes Lease Application of City of Redmond, Oregon*. Mineral Report, Serial Number M-12386, US Department of the Interior, Bureau of Land Management, Portland, Oregon.

Larson, Charlie, and Jo Larson

1987 *Central Oregon Caves*. ABC Publishing, Vancouver, Washington.

Lyman, R. Lee

1983 Site form for Redmond Caves 35DS173. On file, Oregon State Historic Preservation Office, Salem.

Lyman, R. Lee, Michael A. Gallagher, Clayton G. Lebow, and Mary Kathryn Weber

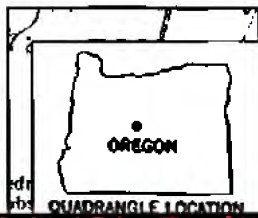
1983 *Cultural Resource Reconnaissance in the Redmond Training Area, Central Oregon*. Department of Anthropology, Oregon State University, Corvallis, Oregon. Report submitted to the Oregon Military Department, Salem, and the Bureau of Land Management, Prineville District.

Scott, Sara A.

1986 *A Cultural Resource Survey of the Deschutes River, from Bend to the Deschutes/Jefferson County Line, Deschutes County, Oregon*. Report submitted to the Deschutes County Community Development Department, Bend, Oregon.

Stranahan, Martha

1978 Redmond Caves Beckon. *The Redmond Spokesman*. 28 June:12.



(b) (3) Cultural Resources (ARPA & Sec. 304, NHPA)

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Figure 1. Redmond Caves project location.